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[OFFICIAL NOTICE.]

### Third Annual Meeting, Michigan Gas Association.

SAGINAW, MICH., Jan. 20, 1896.

The third annual meeting of the Michigan Gas Association will be held on Wednesday, the 19th of February, at the Hibbard House, Jackson, Mich.

The morning session will be called to order at 9 o'clock, in the parlors of the hotel, and everything possible will be done for the comfort of the visitors.

The Association extends a most cordial invitation to any officer or employee of any gas company, and to representatives of firms dealing in supplies, to meet with it at this time, and to put in application for membership.

It would be advisable to engage rooms in advance; rates will be $2, $2.50 and $3 per day. It is requested that members be on hand promptly.

As the titles of all papers have not as yet been received, the publication of the list is deferred until later. HENRY H. HYDE, Sec'y.

[OFFICIAL NOTICE.]

### February Meeting, Guild of Gas Managers.

OFFICE OF THE SECRETARY, Jan. 23, 1896.

The February meeting of the Guild of Gas Managers will be held at Young's Hotel, Boston, Mass., at noon, Saturday, Feb. 8.

A. K. QUINN, Sec'y.

[OFFICIAL NOTICE.]

### February Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, Jan. 23, 1896.

The February meeting of the Society of Gas Lighting will be held in the Arena, No. 39 West 31st street, New York City, on Thursday, Feb. 13, at 3 P.M.

FRED. S. BENSON, Sec'y.

[OFFICIAL NOTICE.]

### Twenty-sixth Annual Meeting of the New England Association of Gas Engineers.

OFFICE OF THE SECRETARY, LYNN, MASS., Jan. 16, 1896.

The twenty-sixth annual meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, on Thursday and Friday, February 20 and 21, 1896.

The meeting will be called to order at 10 A.M., Thursday, February 20. A good list of papers, whose titles and authors will be announced later, have been promised.

The topics for discussion which proved of so much interest last year will be continued this year, and several gentlemen have arranged to speak on the subjects already selected.

The Question Box will be a feature as usual. Members will please forward to the Secretary, as early as possible, any questions they would like to bring before the meeting.

The members will dine together on Thursday evening.

Application blanks may be had of the Secretary. Applications for membership, and all other matters requiring the consideration of the Directors, should be sent to the Secretary before Wednesday, Feb. 19.

*Important.*—Please note the change of date of the meeting from the regular date, which would fall on Wednesday, Feb. 19 (Ash Wednesday), to Thursday and Friday, Feb. 20 and 21, in compliance with vote of Association, passed some years ago. C. F. PRICHARD, Sec'y.

## BRIEFLY TOLD.

MR. PERRY'S UNEVEN PREMISE.—In our last issue we published a letter from Mr. Nelson W. Perry, E.M., in which he apparently controverts some statements made in our previous editorial comment upon his contribution to *Cassier's Magazine* entitled "Gas Engines for Electric Light and Power." While we do not wish to make this subject controversial, we cannot refrain from calling attention to the fact that Mr. Perry substantially agrees with us, although his communication was not so intended. We believe that our representations were supported by figures that were undeniably correct and that the deductions therefrom were so clearly set forth as to admit of neither ambiguity nor misconception. In speaking of the deterioration of the light-giving properties of the incandescent electric lamp, as compared with that of the mantles employed in the Welsbach incandescent gas lamp, and the relative proportions of electrical energy and gas required, our calculations were made upon a "per candle

power per cubic foot of gas" basis. We admit that when incandescent electric lamps, connected in multiple, decrease in candle power, the filament becomes more highly resistant, and consequently does not admit of the passage through the lamp of the same current as when originally placed in the sockets, but we still contend, and Mr. Perry agrees with us, that the expenditure per candle power in the incandescent electric lamp is far in excess of that in the incandescent gas lamp. Speaking of the discrepancy being more marked had Mr. Perry taken, as he states, "the best electricity could do, the arc lamp," we cannot but say that the arc lamp should not be considered. As an interior lighting agent the arc lamp cannot be commercially considered. The heights of ceilings and the general arrangement of places of business preclude its general use, and hence neither its mean spherical illumination nor its plane of maximum illumination can be taken in comparison.

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A Ridiculous Ordinance and the Plight of Its Sponsor.—In our item columns will be found the text of an ordinance, introduced to the attention of his colleagues on the Board of City Council of Chicago, by Ald. John Coughlin, which has for its object the substitution of the City Treasurer for the local Gas Company as the custodian of the moneys deposited by intending gas consumers as a guarantee that they will not default in their payments for gas consumed. The measure is so harmoniously ridiculous that its propositions call for no criticism from us; but ridiculous as the thing is, it nevertheless received the sanction of the Aldermen, and is at this time of writing in the possession of Mayor Swift for his signature or disapproval. Whether he signs it or not, though, is immaterial, for it is on its face as illegal as it is ridiculous, wherefore it could have no life after subjection to review by the courts. The joke of the thing, however, is upon its introducer (Ald. Coughlin), who little suspected that his scheme would be acted upon so quickly and so favorably. The Alderman (the ordinance having been read) secured the floor and loosened his tongue to the play of a florid speech in which he extolled the merits of the measure and waxed warm enumerating the rapacities of the Gas Companies—just after the usual manner of the Chicago Alderman—and wound up by moving that the ordinance be referred to the Committee on Gas, Oil and Electric Light. Anybody who has had experience in such matters knows full well that which Coughlin had in mind by such a reference. Mayor Swift, however, at this juncture, stepped in as a marplot. His Honor wanted to know why, if this thing was the grand and virtuous measure that its proposer declared it, the need for a reference, and suggested that it be passed at once. Coughlin arose, stammering and stuttering, and before he could recover his normal wind-flow condition, somebody moved "to include the ordinance in the omnibus," and the resolution went through with a rush. Subsequently the whole "omnibus load" was indorsed, and Coughlin collapsed. Perhaps Coughlin's next effort will be in the nature of an attempt to have the salaries and labor payrolls of the Chicago Gas Companies made up by himself, with the further right reserved to him to act as paymaster.

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Notes.—The City Gas Light Company, of Norfolk, Va., is now safely ensconced in its handsome new office building, No. 58 Plume street, near Granby street. The annual meeting of the Company was held some days ago, and the shareholders had ample reason for congratulating themselves over the business that fell to them in 1895. The election resulted as follows: Directors, A. W. Stark, C. S. Allmand, M. T. Cooke, C. W. Grandy, J. H. Core, A. J. Goodrich, F. S. Taylor, R. P. Waller and J. G. Womble; President, A. W. Stark; Vice-President, C. S. Allmand; Secretary, Wm. N. Grubb; Superintendent Gas and Electric Departments, Frederic Egner.——The Hon. Robt. A. Cochran, President of the Maysville (Ky.) Gas Company, died at his home in Maysville about a fortnight ago. He was in his 74th year.——The harpers against the Hartford (Conn.) City Gas Light Company may go on with their harpings, but Gen. Harbison and his associates keep marching on to their own music. The Company has secured the plot of land that it has coveted for some time, on the west side of Front street, and in due season the tenements now covering the site will give way to a 3-lift holder.——The Directors of the Lexington (Ky.) Gas Company have declared a semi-annual dividend of 3 per cent.——Mr. Michael J. Gallivan has resigned from the position of Gas Inspector for Buffalo, N.Y. The resignation is to take effect on the 1st prox.——Mr. D. E. Martin has been elected President of the Oakland (Cal.) Gas, Light and Heat Company, vice the late Mr. J. W. Coleman. Messrs. Thomas Crellin and John A. Britton were elected to fill the vacancies on the Board of Directors.——At the annual meeting of the Springfield (O.) Gas Light and Coke Company the officers chosen were: Directors, Governor Asa S. Bushnell, Col. J. W. R. Cline, Hon. Ross Mitchell, Capt. A. Winger and Hon. J. F. McGrew; President, Gov. A. S. Bushnell; Secretary and General Manager, Col. J. W. R. Cline.

## On the Determination of Carbon Dioxide by Absorption.

By H. Heidenhain.[1]

Of all the methods for the determination of carbon dioxide the absorption method is the most reliable and most correct. It is, however, not easy to obtain good results with an absorption apparatus. The inexperienced generally get varying results; after some practice the results become uniform, but either too high or always too low. The application of a corresponding correction may be used with advantage in such cases, but one must admit that this is a makeshift only. As long as the causes for the excesses or shortages are unknown, the influence of such causes can not be estimated, and therefore one is always uncertain whether the applied correction actually compensates the error.

I therefore decided to seek the causes. If I could not remove them, I would at least measure their influence. The correction which was so far found by merely empirical methods could then be calculated from the obtained data. Thus the method would be brought beyond dispute, at least from the scientific standpoint.

The method and the apparatus which I shall discuss in the following are those described by Fresenius.[2] Before going into details, I may briefly remind the reader of them. The carbon dioxide is developed by boiling with a dilute acid. A mixture of carbon dioxide, air and water vapor is generated, from which the latter is removed first. From the remaining gas mixture carbon dioxide is absorbed. These operations are performed by a current of air free from carbon dioxide. Consequently the apparatus has to provide for

(1) an air purifying device,
(2) a developing apparatus,
(3) a drying apparatus,
(4) an absorption apparatus,
(5) an aspirator.

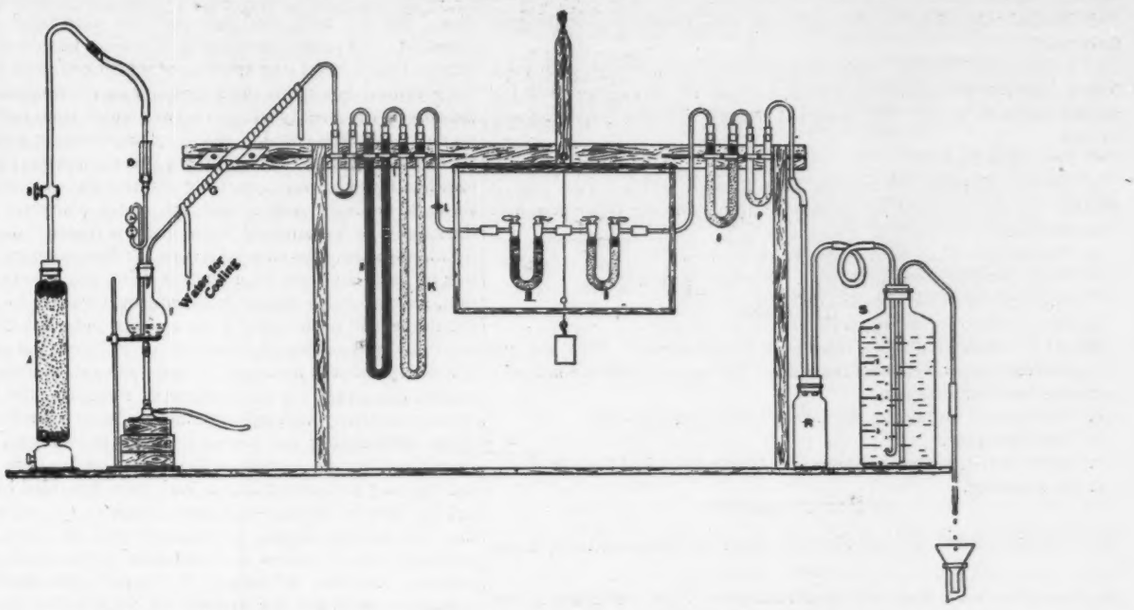
Each of these parts must do its work perfectly, if good results are to be obtained. This can be easily accomplished as to the air purifying and the drying apparatus by making them amply large. The evolution flask can be rather small with substances which do not foam, but with foaming substances like baking powder the size of the flask must be chosen according to the practical requirements. For our work a capacity of 300 cc. is sufficient.

The absorption apparatus occasions some difficulty. Its size is limited by the capacity of the analytical scale. We use **U**-tubes filled with soda-lime and calcium chloride as recommended by Fresenius. My experience is that these tubes contain generally too litle calcium chloride, whereby losses are caused. Soda-lime loses some mixture in a current of air dried by calcium chloride. In order to retain the moisture a considerable length of calcium chloride must be provided at the end of the second **U**-tube. Fresenius prepares both tubes alike and exchanges them after the first use in order to have the fresher filling in front the second time. I do not think that this is the best plan. My opinion is that each tube has to serve a particular purpose, and should consequently have a special outfit. In the first tube carbon dioxide is to be absorbed and therefore it must be filled mainly with soda-lime. The second tube has to answer two different requirements. Firstly it has to act as a safety tube to catch any residue of carbon dioxide not absorbed in the first tube. If it is considered that these traces naturally are in a highly dilute state, it seems indispensable that in order to retain them with safety a powerful absorbent must be employed, in other words, a fresh filling. Secondly it has to absorb the moisture which during the operation has been given off by the soda-lime in both tubes. This can be attained only if the current of air passes a rather long column of calcium chloride before leaving the tube. To meet these requirements the second tube is filled half with soda-lime and half with calcium chloride.

As already mentioned, the first absorption tube receives mainly a filling of soda-lime. Only at the end at which the current of air enters a layer of calcium chloride is provided in order to absorb any moisture which may rise from the soda-lime in this direction.

This manner of filling the two absorption tubes has proved very satisfactory. Experience teaches very soon how much carbon dioxide can be absorbed by the first tube with safety and how often the filling must be renewed. We found that with our soda-lime twenty grams of filling can take up one gram of carbon dioxide. The filling of the second tube, which consists of about ten grams of soda-lime and ten grams of calcium chloride, needs renewing but seldom. As we work its weight increases at each determination very constantly by about five

1. Journal American Chemical Society.
2. Quant. Anal. I, page 449, and II, page 308.




milligrams, whether the quantity of carbon dioxide be large or small or a blank determination be made. This proves that the small increase is caused entirely or almost entirely by moisture. When after repeated use the total increase amounts to about two-tenths gram, it is observed that the increase diminishes and at the same time the results are low. Therefore we renew the filling as soon as the total increase amounts to one-tenth gram.

The aspirator is another part to which, in my opinion, not enough attention is paid. As will be shown later in this article, the aspirator must allow a perfect regulation of the air current and must show the quantity of air used. Both are easily obtained by employing a Mariotte's bottle.

As to the manner in which the method is to be carried out, the following points seem to be worth noting. It is evident that the current of air must not exceed a certain rapidity if the absorption is to be complete in all parts of the apparatus. As the absorption of carbon dioxide by soda-lime takes place, according to general experience, very easily and quickly, there is practically no danger of loss. Long columns of calcium chloride in the drying tubes secure proper absorption of moisture in this part. It remains only to make the absorption of moisture in the second weighed tube perfect. In my opinion it is impossible to give on this point any definite rules which can be followed in all cases. On the contrary the maximum rapidity admissible must be found by experiments, not only for each apparatus, but also for each new lot of absorbents, as especially the commercial soda-lime has a varying content of moisture.

In order to find the allowable rapidity of the air-current one may proceed practically as follows: The apparatus is charged exactly as for an analysis except that the carbonate is left out; in other words, a blank experiment is made. The aspiration is started with a rapidity of fifty cubic centimeters per minute. After two liters of air have passed it is interrupted. If the absorption tubes show a loss in weight, the experiment must be repeated with less rapidity, say forty cc. per minute, and in this manner must be continued until the weight of the tubes is constant. If the work has been done with due precaution it will now be found that the first tube has lost just as much as the second has gained. If this is not the case it is a sure indication that the result is due to a compensation of errors.

The ascertained maximum of rapidity of the air-current must not be exceeded in determinations; a slower rate is unobjectionable. It may be mentioned here that the calcium chloride in the second tube must be of the same quality as that in the drying apparatus, which is also evident from the remarks made by Fresenius.

Further it is manifest that a certain quantity of air must be aspirated in order to transfer all carbon dioxide from the evolution flask and the drying apparatus to the absorption tubes. The common directions on this point, as for instance two air-bubbles a second for half an hour, and similar rules, are too indefinite, and in fact do not suffice. On the contrary, the required quantity of air must be determined for each apparatus. This is done simply by liberating about half a gram carbon dioxide in the evolution flask, aspirating a certain quantity of air, for instance one-half liter, weighing the tubes and repeating the aspiration until the weight of the tubes remains constant. As a precautionary measure some addition is to be made to the minimum thus found.

In order to regulate the current of air and to keep it constant some skill is required. The aspirator must not be put in operation before the air in the apparatus comes to equilibrium, which generally is the case after the liquid in the evolution flask has boiled a few minutes. The flame is then reduced just far enough too keep the liquid slightly boiling. Now the aspirator is connected and the water allowed to run off until it comes to a standstill. Now is the time to open the cock between the evolution flask and the air purifying apparatus. Immediately the outflow from the aspirator starts and becomes constant after a few seconds. By aid of watch and measuring cylinder the speed is soon regulated.

We make it a rule to aspirate with but half the allowable rapidity until the main quantity of carbon dioxide is absorbed, *i. e.*, until the soda-lime tube has recooled; from then to the end of the operation the full speed is used. It may be said that in our work these speeds are respectively ten cc. and twenty cc. per minute.

The flame remains burning during the whole time of aspiration. If the flame were extinguished the air in the revolution flask would cool and contract, making a regulation of the air-current impossible.

Another point often overlooked is the presence of carbon dioxide in distilled water and laboratory air. There is too much in both to neglect. The whole apparatus including the evolution flask, must be filled with air free from carbon dioxide and the distilled water must be freed from it, by boiling with a little acid. In pouring the water into the evolution flask air must not be allowed to enter.

Finally, corrections for changes of temperature and air-pressure are indispensable, as the tubes and their contents occupy a rather large volume.

In regard to accuracy of our results little remains to be desired. Blank determinations give a gain or loss of not more than two-tenths mg., and determinations of carbon dioxide in clear crystals of Iceland spar give, if one gram is employed, results which vary from 44.01 to 43.96 per cent. The explanation for these slight variations may be found partly in the inexactness of the weighings, of which four must be made for every determination, and partly in the quantity of moisture condensed on the surface of the tubes, which varies according to the moisture in the surrounding air.

It may be well to append a sketch of the apparatus as modified by me. Great care has been taken to draw all parts in proper proportion. The ratio is 1 : 12. Some explanations in regard to details may follow:

*a.* Air-purifying cylinder, filled with soda-lime. At the top is cotton to keep back soda lime dust.

*b.* Cock to regulate the air-current.

*c.* Capillary tube to offer resistance to the air-current in case cock *b* is opened too far.

*d.* Funnel tube, closed at the bottom by a perforated rubber stopper into which

*e.* a glass tube is fitted. This arrangement, in connection with cock *b*, is a substitute for a three-way cock, but has the advantage that the regulation part, *i. e.*, "*b*" does not become wet and is not exposed to heat.

*f.* Evolution flask.

*g.* Cooler. Consists of a glass tube around which a lead pipe is wound. It was adopted by us on account of varying water pressure. It stands sudden changes of pressure very well.

*h.* Drying tube filled with coarse calcium chloride.

*i.* A little pumice stone prepared with copper sulphate.

*k.* Drying tube filled with fine calcium chloride.

*l.* Cock to close drying apparatus when not in use.

*m* and *n.* Absorption tubes, filled as described above. They are put in a glass case to protect them from dust. The connections are made by perforated rubber stoppers.

*o.* Guard tube, containing calcium chloride and soda-lime.

*p.* Indicator tube.

*r.* Safety bottle, to receive water which may be sucked back from

*s.* the aspirator.

## The Prepayment Gas Meter System in Birmingham, Eng.

[Extracts from an article in the Birmingham *Post* published in the London *Journal*.]

The introduction by the Gas Committee of the Birmingham City Council of the system of prepayment meters into the houses of the working classes has been so successful that its development is only a matter of time; indeed it may ultimately compel the consideration of the question whether the scheme could not with advantage be extended to all kinds of house property, and, perhaps, to many business premises. The necessity of doing something to popularize the use of gas in small houses has for a long time occupied the attention of various gas companies, and especially the department in Birmingham. It was found that the number of small meters was rapidly diminishing, mainly through the practical abolition of the three-light meter, in consequence of the gas being extended to other purposes than that of lighting. When the Birmingham Corporation acquired the gas undertaking from the old Companies, they became aware that the number of small houses in which gas was used within the area of supply was very much smaller than in many other manufacturing districts; and they devised various means for attracting that class of consumer by relaxing the system adopted by their predecessors of asking for deposits as security and abolishing the fourth scale of charges—a scale by which consumers of gas under 10,000 cubic feet per quarter had to pay a higher charge. This was a concession which was decidedly in favor of the small consumer; but, notwithstanding this liberality, very little progress was made. In 1877, it was estimated that the consumption per meter in the small houses would be so inconsiderable that it could only be supplied at a loss; and the Gas Committee, who had once more had the matter before them, abstained from making any special effort to enlarge the scope of their business in those tenements. Matters remained in abeyance until about six years ago, when, as the result of a discussion in the Town Council, careful inquiries were made as to the practicability of increasing the supply of gas to the better class of small houses. The Committee came to the conclusion that it would be desirable to extend the convenience of gas lighting to such houses; but they also recognized that, in justice to other consumers, they must act impartially, and strictly on commercial lines. By way of experiment, seven streets were selected at random in different parts of the suburbs; and an inspection revealed the fact that, of the 400 dwelling-houses fronting the streets or in the open terraces, not more than 100 of the householders used gas, although supply-pipes had been provided by the landlords to about 200 houses. This clearly showed that, before anything else could be done, it would be necessary to persuade the tenants of the houses already supplied with pipes to use the gas, and also to induce the landlords in the other houses to put in fittings. Another difficulty, however, then arose in the discovery by the Committee that many of their own workmen who resided in houses fitted with pipes used oil as an illuminant, because they found in their household economy that it was easier to pay weekly for oil than quarterly for gas; and consequently it became apparant that a weekly collection must be instituted if the system for supplying these small houses with gas were to be at all a success.

About this time the first form of prepayment meter made its appearance; but by 1891, the automatic or coin-freed meter had been invented. An experiment was then tried in twenty-six artisans' dwellings in Ryder street (the erection of which had been undertaken by the Corporation); but it was not altogether an encouraging success because the cost of the weekly collection was more than sufficient to swallow up any profit that could be made. Concurrently with the experiment, similar meters were fixed in fifteen private houses, for which the landlord had hitherto paid quarterly for the gas consumed by his tenants through ordinary meters, and had charged them a weekly sum for the supply. A change of meter in these fifteen houses was beneficial for nine tenants, who effected a considerable economy in their consumption of gas. In view of a further trial, the arrangement was made that, instead of the money being collected weekly by special officers, it should be paid in the rent by the tenants under the Corporation. But even this system, though operative in reducing the cost of the supply, did not obviate the necessity of frequent examination of the meters by trained inspectors, for the purpose of removing the difficulties which arose principally through the meters being temporarily disabled by coins interrupting the working of the mechanism. The consumers exercised economy in various directions; and in those houses in which not only the permanent fittings had been provided by the Corporation but the tenants' fittings—pendants, brackets, etc.—also, care was taken that the fittings should be supplied with the most modern type of governed burner, so that the consumer might obtain the best light for a penny. Another advantage of the new arrangement was that the consumer could test for himself the accuracy of his own meter. He was told that he had a governed burner consuming 5 cubic feet per hour; and it was easy, therefore, for him to see, when he had paid a penny in advance for 25 cubic feet of gas, that he obtained five hours' light for the payment. One interesting fact revealed during the experiment was that the consumption of gas was smallest in the lowest-rented houses. For instance, in a house rented at 5s. a week, it was found that the consumption was not more than half that in a house let at 7s. 6d. per week.

From 1891 to 1893, the experiment was tried in 103 houses erected by the Corporation, and in 63 houses owned by private landlords. The Gas Committee, therefore, had sufficient experience to enable them to arrive at a conclusion as to the value of the system. Two things were apparent—first, that the weekly collection must be dispensed with on account of its cost; and, second, that some further encouragement must be given to the use of gas in order that the consumption per meter might be sufficient to make the supply remunerative. Apart from the provision of the tenants' fittings, the cost of which was included in the charge for gas, the capital outlay on the installation could not be less than £3; while, under the most economical arrangements, it was probable that the cost of collecting the pence and supervising the meters, bookkeeping, etc., would involve an additional 6s. or 7s. per annum. Having arrived at this conclusion, it was necessary to do something to increase the consumption per meter. Inquiries made in other towns showed that the supply of the "penny-in-the-slot" meters had led in nearly all cases to a demand for gas for heating purposes—either a small boiling stove or, as in a large number of cases, a small cooker. In fact the experience of the larger houses was repeated in the smaller. Consumers having gas in their houses—especially in those where early breakfasts had to be provided and mid-day cooking had to be done in the living room—were quick to appreciate the advantages of the use of gas for cooking purposes, particularly in the summer months, when it would obviate the necessity of a fire throughout the day.

Although the Gas Committee has hesitated in the first place to include boiling-stoves in their "penny-in-the-slot" arrangement, they were convinced by the experience of other towns that it was a necessary part of the system, and would solve the difficulty as to the minimum consumption required to make it pay. With regard to the weekly collection, this difficulty was overcome by the meters being made sufficiently large to receive the coins necessary for a whole month's consumption, or even a longer period. Of course, there are still some difficulties to be surmounted before the scheme is perfect. The department has made it one of the conditions of supply that the consumer shall, at each monthly collection, pay the difference, if any, between the consumption registered in measures of 25 feet, and that registered on the ordinary index of the meter; or if the difference is in his favor, the balance shall be returned to him. This difficulty is materially reduced by the provision of a supplementary index on the meter showing the number of pence deposited; so that the consumer can not only check the inspector as to the quantity of gas burned, but as to the amount of pence taken from the box. It is interesting to note that, during the

four years the new system has been in operation in Birmingham, there has only been one case of attempted fraud, and that was a case in which a workingman, in temporary possession of a house, endeavored to get a supply of gas by means of a metal disc. It may be a piece of useful information to anyone else who thinks he can impose on the department in a similar manner to say that in the case alluded to the metal disc was rejected by the meter.

More than 1,000 meters were fitted in small houses in Birmingham last summer; and the supply since has only been arrested because of the impossibility of employing the fittings staff on the work during the winter. Several hundred applications are on the books; and they will be met as soon as possible. It is expected that, in the light of recent experience, the demand will be much greater during the early spring. The success of the new meter in small houses may, perhaps, ultimately lead gas managers to provide similar fittings for houses of all sizes, because it may be contended that, if the meter is advantageous and economical in a small house, it will be in a large one. This contention will be supported by the fact that no complaints have been received about the quality of the gas supplied under the new conditions, and that, when the burner fails, it is the duty of the department to renew it. It may further be found possible to use the meters in manufactories, where the waste of gas would be prevented, and a check put upon the workmen, by the prepayment system. Mistresses who keep a staff of servants may also discover its utility in the kitchen, just as the house wife does in a small tenement.

## Effective Center of Light from a Standard Photometric Burner.

By Clayton H. Sharp, Ph.D., in *Electrical World*.

In an article which was read before the American Society of Mechanical Engineers, and which was given in abstract in the *Electrical World* of Dec. 14, 1895, Mr. D. S. Jacobus[1] describes an experimental determination of the effective center of light for a London Argand burner having a wide, horizontal slit. This problem is precisely similar to that of finding the effective center of light for the Vernon-Harcourt pentane lamp. The theory of this form of light standard is extremely simple, and since it does not seem to be very generally known, it may be given here.[2]

Let $I$ be the intensity of the source and $i$ be the intensity of unit height of flame considered as a uniform cylinder. Let $H$ be the height

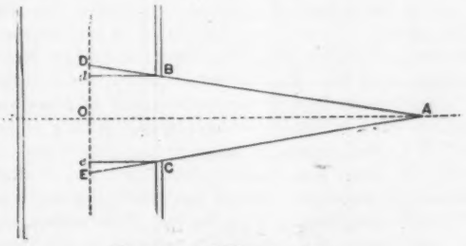



**Diagram of Photometer.**

of slit $B\,C$, in figure, and $D\,H = D\,d + E\,e$, the increase of height due to parallax.

Then $I = i\,H + i\,D\,H$.

If $R = r$ represent the distance from the flame axis to the photometer disc and to the edges of the slit, respectively, we have from similar triangles—

$$\frac{R}{r} = \frac{H + D\,H}{D\,H} \text{ and } D\,H = H\,\frac{r}{R - r}$$

$$\text{Then } I = i\,H\left(1 + \frac{r}{R - r}\right) = I^1\,\frac{R}{R - r} \quad [3]$$

In which $I^1 = i\,H$, being the intensity of the source due only to the portion of flame having the height $H$.

The intensity of illumination on the photometer disc will be—

$$I^1\,\frac{\frac{R}{R - r}}{R^2} = I^1\,\frac{1}{R\,(R - r)} = \frac{I^1}{\left(R - \frac{r}{2}\right)^2}$$

approximately, since $R$ is much greater than $r$.

1. See Journal, Dec. 16, 1895.

2. See Liebenthal, *Electrotechnische Zeitschrift* for October, 1895.

3. Or, since intensities are proportional to the amount of flame exposed, we see at once that—

$$\frac{I}{I^1} = \frac{D\,E}{B\,c} = \frac{R}{R - r}$$

Hence the effective center of the source is at a distance equal to half of the radius of the screen in front of the axis of the flame.

In Mr. Jacobus' experiments $r$ was equal to $1\frac{7}{8}$ inches, and the effective light center was found to be $\frac{9}{16}$ inch from the axis of the flame, these two quantities stand to each other in the ratio of $\frac{1}{2}\frac{7}{3}$—a close approximation to the value indicated by the theory.

The errors arising in certain cases, from a failure to make a proper setting of a standard, having a screen of this sort, are much larger than one at a first thought would expect, and serve strongly to emphasize the necessity of using great care and forethought in making even the simplest photometric measurements.

That an error of a similar kind may occur in the use of standard candles has been illustrated in a striking manner by an experiment made by Mr. Wm. Sugg.

The axis of the flame of an English standard candle is not, in general, the prolongation of the axis of the candle itself, but lies at one side of this axis, in a position which depends on the size of the flame, and on the curvature or curl of the upper part of the wick. As the wick burns down, exposing fresh parts to the heat, it will twist about, carrying with it the axis of the flame. Thus the position of the light center in respect to the photometer bar may be materially changed.

Mr. Sugg took a series of photographs of the flame of a candle which had been adjusted so that the flame axis coincided with the prolongation of the axis of the candle. These photographs show how in the course of a little time the wick twisted far enough to notch the flame of the curl of the wick through 90°, bringing the axis of the flame a noticeable distance nearer the photometer bar.

It is to be noted that errors of this sort are minimized by the use of a *long* photometer bar. On a bar 200 inches long they become, in general, comparatively insignificant. Such a bar presents this additional advantage, the error arising from the considerable size of the luminous source as compared with the distance between the source and the photometer disc is decreased, while the coarser divisions render it possible to take readings of photometer settings with great quickness and facility. The diminution of the intensity of illumination on the photometer disc involved in the use of a longer bar is not of practical importance when dealing with the comparatively powerful light sources used to-day.

## Steam.

By C. A. Collett.[1]

It is said that fools rush in where angels fear to tread, and when we call to mind the alarming frequency of steam boiler explosions and their disastrous effects upon life and property, we are forced to admit the truth of this adage.

The mechanic who undertakes to construct an engine or other machine without first obtaining a full knowledge of the properties and nature of the material used in such structure is almost sure to fail; and the engineer who takes charge of a steam engine, or uses steam for any purpose in the mechanic arts or in manufacturing, should first acquaint himself with its nature and properties. Now, in order that we may the more fully understand the nature and properties of steam, it may be necessary to touch upon its natural chemical composition and properties in a general way.

Water is looked upon by many as a common and simple element, and the mode of converting it into steam is known by everyone. Not so, however, with its constituents and properties when in the gaseous form. The analysis of steam, such as is usually generated in the ordinary steam boiler, has yet to be made, and consequently many vague theories and ideas are advanced. We can safely affirm that ice, water and steam are one and the same substance, only that they are of different degrees of temperature. This may appear paradoxical, but it is nevertheless true. It is evident then that the temperature gives different properties to the same substance—water. The highest point to which ice can be raised and maintained as ice is 32° F., but the highest to which water and steam can be raised has not yet been accurately determined. We are told that Dr. Lardner generated steam under a pressure of 1,000 pounds per square inch, which would correspond with a temperature hot enough to melt lead. We know that at atmospheric pressure water evaporates into what is known as steam at 212° F., and above or below that point in accordance with the pressure to which it is subjected, and in proportion to the units of heat applied.

Steam and water can exist in their respective forms at all temperatures above 32° F.; and, in fact, steam is known to exist much below the freezing point. We may say, just at this point, that we make no

1. *Safety Valve.*

distinction between what is called vapor and steam; and in fact there is none, except temperature. When the temperature of the air falls sufficiently below that of the water in our bays and rivers, steam is given off from their surfaces and becomes visible when condensed in colder atmosphere. Steam can be condensed in the atmosphere by any cold substance being placed in it. A pitcher filled with ice will illustrate this. Steam is given off from our bodies at nearly the same temperature as the air. To prove this we have only to breathe on a piece of cold metal or glass, when condensation ensues and the water can be easily collected.

When the atmosphere is much colder than our bodies this steam is made visible by condensation, and when the temperature is sufficiently low has been frozen into ice upon the beard. We have said here that steam was made visible, but when visible it is no longer steam, but minute globules of water of infinitely small proportions, which, by their attraction for each other, under favorable conditions, form drops and fall in rain, or are evaporated again and carried of in the thirsty atmosphere. Pure steam is composed of two volumes of hydrogen and one of oxygen gas; or, by weight, one of hydrogen and eight of oxygen. If two cubic feet of hydrogen and one of oxygen are united they will form only two cubic feet of steam, or a volume equal to that of the hydrogen, and equal in weight to both. Steam is three-eighths lighter than common air. An atmosphere of pure steam would only weigh a little over 9 pounds, yet water, of which it is composed, is 770 times heavier than air, it being in weight as 1, nitrogen 14, oxygen 16.

The thermometer being the instrument generally used for measuring degrees of heat, might be more properly termed degrees of expansion and contraction in the liquid or metal used in its construction. Quantity of heat cannot be measured by the thermometer, although it is indicated by the expansion of the material of which the thermometer is composed, to be either more or less intense. The galimometer is the most sensitive instrument in use for measuring minute differences in temperature. This instrument will not indicate quantity, but will indicate or detect the presence of heat, though insensible to the ordinary thermometer. The calorimeter is a device for measuring quantity. It consists of a glass vessel having two annular chambers, the inner one to contain the liquid or material to be tested, the other two chambers to contain pounded ice—the outer chamber of ice to prevent the action of the heat in the surrounding air from acting on the ice in the middle chamber. The quantity of heat is then obtained by the quantity of ice. The substance under test will dissolve in the middle chamber, and can be ascertained by the weight of water thus collected from the ice in the middle chamber; yet this will not give accurate quantity, as all the ice thus dissolved cannot be collected, a portion of the water being retained in the ice by capillary attraction, even though no heat were lost while conducting the operation.

Watt gives the latent heat of steam at 1 atmosphere as 988° F.; at 10 atmospheres as 840°. Watt's theory being that 1,200° degrees is the total heat contained in saturated steam, and that as sensible heat increases latent heat diminishes. In measuring the quantity of heat contained in steam the ordinary thermometer is useless. An approximation to quantity is made as follows: 1 cubic inch of water generated into steam contains sufficient heat to raise the temperature of 5½ cubic inches from 32° F. to 212°, making in all when condensed 6½ cubic inches of water at 212°, yet the steam only indicated 212°. Hence, if we multiply 6½ by 212°, and deduct the 32° contained in the 5½ cubic inches of water we will have 1,202° as the amount of heat obtained from 1,700 cubic inches of steam, or the amount necessary to evaporate 1 cubic inch of water into steam, yet the steam will indicate, by the thermometer, as having only received 108°, when, as shown by the above calculation, it has received 1,170°, and yielded up to the 5½ cubic inches of water 990°. If we go on a little further, we will find that this heat was diffused throughout 1,700 cubic inches of space occupied by steam—and here quantity takes the place of intensity—each atom of steam requiring its unit of heat to hold it in the gaseous form, for if 1 atom should lose its required unit of heat, it would be no longer steam, but would become water, and perhaps carry several of the surrounding atoms with it to the liquid form.

If we could compress the 1,700 cubic inches of steam into one-half its volume without loss of radiation or condensation, we would find an indicated increase in temperature of 38°, and it would continue to increase as the volume was reduced. Water at the boiling point cannot be made to indicate any higher temperature than 212°. No matter how intense the heat applied, an increase of ebullition, a more violent boiling, is all that is indicated until the body of water is all evaporated. It is during this period that the seemingly lost heat is carried off into the increased space occupied by the steam.

Rumford says that steam contains heat enough to raise ten times its own weight of water 102°, or 102 times its own weight 10°. Water is the greatest absorbent of heat of any substance. If we take equal weights of water and iron and raise them to the same temperature, it will be found that the water contains ten times the amount of heat. The heat required to raise 1 pound of water 1 degree will raise 4½ pounds of air to the same height. Again, if 1 pound of mercury be heated to 160° F., and 1 pound of water to 40°, and mixed together, they will give a temperature of 45°. But if the water be heated to 160° and the mercury to 40°, and then mixed together, they will give a temperature of 155°. The 5° taken from the water will indicate an increase in the mercury of 115°. On the other hand, the 115° taken from the mercury will only indicate 5° in the water; showing that the different bodies have different capacities for heat. Water, although the greatest absorbent, is a poor conductor of heat. It can be boiled in a vessel only a few inches in depth, and emit steam from its surface without materially increasing its temperature at the bottom. In a very long steam boiler, with an intensely hot furnace, steam will be generated in the front end of the boiler, while the other end is comparatively cold. Hence great care should be exercised in raising steam in a cold boiler in order to avoid excessive strains from unequal expansion.

The ease with which steam gives out its heat is of great annoyance to the engineer, and also of great service in the condensing steam engine by its rapidity of condensation. Many devices have been resorted to to prevent the radiation of steam, such as jacketing, and superheating it in the boiler. Superheating has been applied in various ways, and the poor conductive property of steam makes it possible to have steam at different temperatures in the same boiler, unless a very active circulation is kept up. Hence the necessity of having the best water circulation possible in a steam boiler. If pure steam be superheated beyond the point of loss by radiation, it becomes subsaturated or surcharged with caloric, and acts upon the iron of the boiler and engine with deleterious effect. Oxidizing the same, when superheated or supersaturated, its absorbing properties are increased on account of its inclination to become saturated or attain its normal condition. If expanded in a cylinder, it will take up a portion of the water that may have been formed by contact with the colder surface of the engine. When expanded, it falls in temperature, and it follows that the pressure being reduced, the boiling point is also reduced, which allows the greater portion, if not all the water so formed, to flash back into steam, it having obtained the same temperature as the steam at its highest pressure.

A sudden ebullition, which sometimes produces what is called priming, is caused by the same law of pressure regulating the temperature of the boiling point, for water can be heated to any degree to correspond with pressure applied of its own vapor, and might be so confined as not to evaporate at all. The solvent property of fresh distilled water is known to produce the brown substance found in pipes and on the tubes of boilers using it, causing what is termed pitting of iron. This brown product by analyzation is found to contain 79 per cent. of the oxide of iron and 15 per cent. of water, with 1 per cent. of silica. Steam having similar properties as that of the distilled water, when superheated, acts still more powerfully on the iron of the boilers, superheater or engine; and because of this corrosive property in surcharged steam, superheating to any extended degree has been abandoned by many engineers. Notwithstanding all this, there are many earnest advocates of the use of superheated steam among engineers who have given the matter the closest study and research.

An eminent engineer—who is unfavorable to superheated steam—explains superheating as follows: "In order to utilize the maximum effect of steam it is not necessary to overheat it. After a pure steam is formed, that is, when all the particles and bubbles of water are evaporated, water which accompanies the steam in such a form has the same temperature as that due to the surrounding steam pressure, preventing it to vaporize, and when it passes through the superheater the temperature is greatly increased, while the pressure remains the same. It, being in connection with the steam room in the boiler, allows the water to vaporize, and a pure steam is formed. If particles of water with the steam is admitted into the cylinder part of the stroke and then allowed to expand, it is generally found that the end pressure does not come up to that due by theory, from which it has been pronounced that the expansive quality of steam does not follow that of a perfect gas; but if we knew the cubic content of all the particles of water, and subtracted that from the cubic content of the steam, it might be found that its expansive quality is not so far from that of a perfect gas. It appears, also, that the expansive quality is diminished by overheating pure steam."

The relative volume of steam to water is not the same at all pressures,

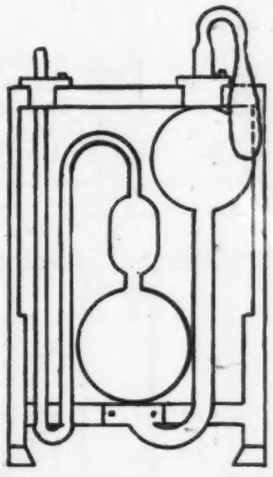
according to the law of gases. For instance, if we take steam at 1,700 cubic inches to 1 of water, at 2 atmospheres we should have only one-half that volume, and at 4 atmospheres one-fourth of the volume; at 8 atmospheres one-eighth, or 212.5 inches, when in reality we have 251 inches at 8 atmospheres; the increased volume being due to the increased temperature at those pressures. Steam, like water, being a poor conductor of heat, makes it necessary to cause nearly all the atoms of steam to come in contact with the heating surface of the superheater to give it a uniform temperature; and to accomplish this superheaters have been made with flattened tubes, others with angular pipes, and in every conceivable form, many of them acting as refrigerators when placed in the uptakes of boilers, from the low temperature in them and the frequent admission of large drafts of cold air when the furnace doors are opened. Pure steam is the vapor of water, free from watery particles, all foreign substances or other compound gases than oxygen and hydrogen, and of a temperature equal to the pressure under which it was produced.

Subsaturated steam is that which has received a higher temperature than that under which it was evaporated, and it can be raised to any degree of heat the vessel will endure in which it is contained, its absorbing properties becoming greater with each degree.

## Improved Gas Pipette for the Absorption of Illuminants.

Mr. Augustus H. Gill submits the following improved form of gas pipette for the absorption of illuminants:

In the use of the apparatus for this purpose ordinarily furnished by the dealers, difficulty has always been experienced in sucking the gas back from the pipette, owing to the moist beads and the glass wool entrapping some bubbles. To obviate this the writer has, for the past two



years, made use of the modification shown at one-fourth size in the sketch. The round bulb, filled with beads and glass wool in the usual form, is replaced by a cylindrical one about 2 inches long and 1¼ inches in diameter, filled with tubes standing vertically, after the manner of the Orsat pipettes. The surface presented is nearly the same, and no trapping of the gas can take place.

The stand is the one already described, and the whole apparatus may be obtained of the Ziegeler Electric Company, of Boston.

## A Method for the Detection of Weak Dynamo Fields.

By Mr. Buckner Speed.

The cotton covering of the wire wound on dynamo fields is subject to deterioration from three principal causes—slow carbonization, due to heat; oil from the bearings, and insufficiently baked shellac. These changes in the insulation of the wire allow the current to pass from layer to layer of the wire instead of all passing through the wire itself, and the field may thereby be greatly weakened, and yet show no ground from the field wire to the field core. The only cure for such weakening is to rewind the spool with new wire.

The spool or spools requiring rewinding may usually be determined with ease if the resistance of each spool be taken when first received from the factory. If, however, the original resistances cannot be obtained, and there is no certainty that the coils all had equal resistances when wound, the faulty coil may be determined as follows:

Measure the resistance of each spool with a Weston voltmeter and Weston ammeter, using currents of various strengths; thus in the measurement of an arc machine the field wire would be connected in series with a Weston ammeter and adjustable resistances for varying the current, which could be supplied from a constant potential generator, for example. The drop across each spool would then be taken with a Weston voltmeter, when the current is held steadily at one ampere, then at two amperes, then at three, and so on up to the normal current, say ten amperes. If the wire covering is in good condition, the resistance of the spool will of course be constant for all currents, or rise slightly, owing to the field becoming warm. But if the spool be "green" from not having been baked, or if it has become soaked with dirty oil, its resistance will be about constant for the weaker currents and will abruptly decrease upon the application of the stronger currents. The writer has measured fields in which this decrease in the resistance of the coil was as much as 20 per cent.

In case of a dry carbonized field the resistance, when hot, will be either less than when cold, or it may remain about the same, or even rise slightly, but in the last case the rise in resistance with heat will be much less than the rise that is caused by the temperature coefficient (0.4 per cent. per degree Centigrade) of the copper.

The writer has had occasion to use the above method on a number of dynamos which showed evidence of weak fields, and it has never failed to correctly indicate the weak spool. Appended is a specimen of one of these tests. The spool was unwound and the wire found to be in very bad condition, the cotton insulation being saturated with oil and colored green with verdigris; there were also large black spots of carbonized and oily wire covering as large as one's hand. Upon rewinding the spool the resistance became constant, as shown in the second table.

Arc Dynamo No. ——.

*Top Left Coil.*

| | | |
|---|---|---|
| 0.50 amperes. | 3.5 volts. | 7.00 ohms. |
| 1.00 " | 7.0 " | 7.00 " |
| 1.50 " | 10.5 " | 7.06 " |
| 2.80 " | 19.8 " | 7.08 " |
| 4.00 " | 28.5 " | 7.12 " |
| 6.05 " | 43.0 " | 7.11 " |
| 8.05 " | 55.0 " | 6.83 " |
| 8.15 " | 55.8 " | 6.83 " |
| 9.70 " | 66.0 " | 6.80 " |
| 9.80 " | 67.0 " | 6.83 " |

*After Rewinding.*

| | | |
|---|---|---|
| 2.9 amperes. | 20.9 volts. | 7.20 ohms. |
| 5.6 " | 40.3 " | 7.20 " |
| 8.5 " | 61.0 " | 7.18 " |
| 9.3 " | 67.0 " | 7.20 " |

For the successful use of this method several points are to be noticed. The Weston instruments are to be in the best of condition, newly calibrated and working without any sticking of their pointers. The instruments are to be removed a very considerable distance from any magnetic influences that will cause erroneous results. The measurements must be taken when the current is steady, readings taken while the current is varying being of no value. The readings on the meters must be large enough to enable an accuracy of observation of at least 1 per cent. To save the voltmeter from injury, its contact button must always be released before breaking the current in the field.

## Clark and Norris Apparatus for Making Gas.

On Jan. 14, 1896, United States Letters Patent (No. 552,889) were granted to Walton Clark and Rollin Norris, of Philadelphia, Pa., assignors to the United Gas Improvement Company, for apparatus for making gas. Using the words of the specification:

Our invention relates to gas making apparatus of the kind in which water gas generators are combined with retorts for distilling bituminous coal, and particularly adapted for use in connection with apparatus such as is described in Walton Clark's patent, No. 404,520, dated June 4, 1889. In this patented apparatus we have found that while it was decidedly advantageous to pass the water gas from the generator through the retorts when freshly filled with coal, the advantage decreased during the latter stages of the distillation of the coal in the retort, and that finally the passage of the water gas through the retort had the effect of

absorbing heat rather than communicating it to the coal. We have also found that where all of the retorts of a set are connected together at one end, as they are in Clark's patented apparatus, the opening of the end of one retort permits flames and gases to escape through it from the other retorts, this being objectionable both as interfering with the

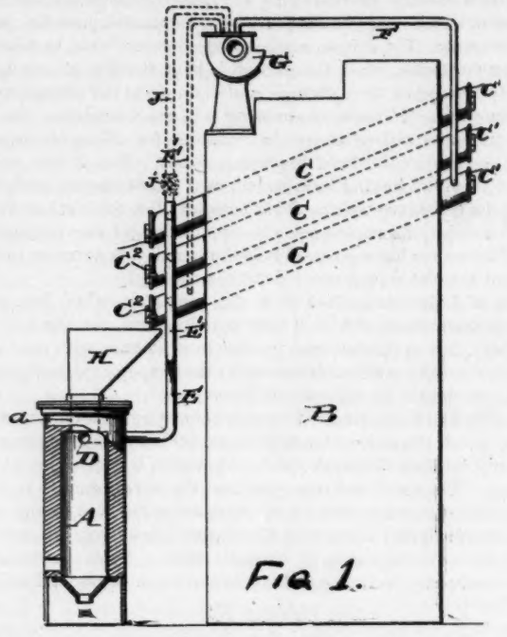


Fig. 1.

proper stoking and from the consequent loss of valuable gases. With a view of obviating the above noted defects and of generally improving and cheapening the apparatus we have devised our present improvement.

Our invention consists in the improved apparatus for carrying out this process, which apparatus will be best understood as described in connection with the drawings in which it is illustrated, and in which—

Figure 1 is a side elevation of a generator and set of retorts constructed and provided with connections in accordance with our present invention. Fig. 2 is an elevation showing two sets of generators and retorts arranged side by side, and Fig. 3 is an elevation showing the charging ends of the retorts.

*A A* indicate the water gas generators, which are of usual construction; *B*, the masonry setting for the retorts, in which setting are formed proper flues, fire chambers, etc., for the external heating of the retorts, such, for instance, as are described in Walton Clark's former patent.

*C C C*, etc., are the retorts, which are preferably set on an incline, as shown; $C^1$ $C^1$, etc., the charging doors of the retort; $C^2$ $C^2$, etc., doors at their lower ends through which their contents are withdrawn. The door $C^2$ should be close to and above the tops of the generators *A*.

*D D* are water gas conduits leading from the generators *A A* into a conduit *E*. The conduit *E* branches in the construction into three conduits $E^1$ $E^1$ $E^1$, from which branches $E^2$ lead to the ends of each retort *C*, valves *e* being provided in each of such branches so that they can be opened or closed at will.

*F F* are conduits leading from the opposite end of each retort *C* to a hydraulic main *G*. The dotted lines $F^1$ indicate conduits leading from near the discharge ends of the retorts to the hydraulic main.

*H H* are hoppers which connect with the charging ports *a* of the generators, and have their mouths arranged beneath the discharging doors of the retort *C*.

In operating our improved apparatus the various retorts of each set are charged with bituminous coal at different times, so that the distillation of the bituminous coal will have just begun in one retort or in a certain number of retorts, while in another retort or a number of retorts it will be partially completed, and in a third set of retorts it will be entirely completed and the coke ready for discharge. The water gas formed in the generator or generators passes through the conduits *D*, *E* and $E^1$, and thence through the conduits $E^2$ to each retort. When a retort is freshly filled with coal the valve *e* in the pipe $E^2$ leading to it is opened, and the water gas then passes through the retort, mixing with the coal gas formed in it, the mixed gas escaping through pipe *F* near its charging door and being connected to the hydraulic main. After the retort has been raised to a temperature in excess of the temperature of the water gas, the valve *e* leading to that retort is closed and the further distillation of the coal continued without admission of any water gas to the retort, the coal gas escaping in the same way as before to the hydraulic main. It is, of course, easy for the operator to determine about how long the valve *e* should remain open and how much of the distillation of the coal should be carried on by external heat alone. Some of the pipes $E^2$ will, of course, always be open, so that the water gas will always escape through some of the retorts to the hydraulic main.

When the distillation of any batch of coal is completed, the discharging door at its lower end is opened, and the stoker opening the charging door pushes the coke out into the funnel *H*, whence it falls into the generator to be used in the manufacture of water gas; or if no fuel is required in the generator the coke can be taken off and stored for future use. The pipe $E^2$ leading to the generator which is being discharged and refilled is, of course, always closed, and as the retort has no communication with either the generator or any other retort of the set, the stoker will not be interfered with by escaping gases nor will any valuable gases be lost.

While we prefer to pass the water gas through the retorts during the portion of each run, it is yet true that many of the advantages of our apparatus can be secured by an arrangement of take-off pipes which do not draw the water gas through the retort—thus, for instance, by carrying the take-off pipes, as indicated by dotted lines at $F^1$, from the same end of the retorts that the pipes $E^2$ lead into. We find it advisable also

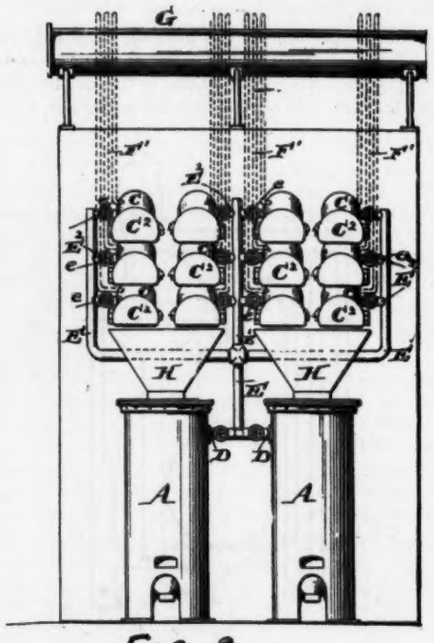


Fig. 2.

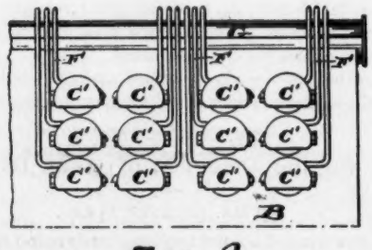


Fig. 3.

to provide a bye-pass pipe leading from the generator to the hydraulic main or receiver—as, for instance, a pipe *J*, Fig. 1, with a valve $J^1$—so that a portion of the water gas can at proper times be led directly to the main without entering the coal retorts.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent, is:

In combination with a water gas generator, a set of coal retorts, water gas conduits leading from the generator to each retort, valves arranged to close each such conduit independently; gas take-off conduits leading from each retort, and a bye-pass leading from the generator to the hydraulic main or receiver.

## The Refining of Petroleum.

*Engineering*, in discussing the topic named in the heading, says that a manufacturer having thoroughly investigated his own position can only derive the fullest profit by being able to compare the result with that reached by a competitor by the same process. This, unfortunately, can only be done, and that very indifferently, by a comparison of the balance sheets of limited liability companies, and if words be given to conceal thought, it may be said that the accountant utilizes figures to confuse details, although stating a general result clearly. Moreover, for one valuable fact in the balance sheet, there are ninety and nine missing. In the United States, on the other hand, the Census Department from time to time issue reports which set up standards whereby manufacturers in the different fields of industry can reach some estimate of the relative merits of the processes adopted in their work as measured by the costs of production and the resultant product. Where we compete with United States makers, these reports are as suggestive to us as to firms on the other side, and a case in point is the returns as to the refining of petroleum. America has ever taken a great part in supplying the world with oil, and has influence even in this country against the Scotch companies, for we import 274¼ million gallons of oil in a year, while they also wage a vigorous competition with Russia. It is true they have a vast natural wealth in petroleum, but this makes it all the more necessary why competitors should study the results of the use of this wealth. It is to be regretted that no figures are available as to British or Russian processes to compare with those for the United States.

In the United States about 1,288 million gallons of crude petroleum are refined in a year, and it will be interesting to investigate the items which make up the total cost of refining. The cost of the crude petroleum averaged $1.52 a barrel—just under 4 cents a gallon—much higher than 10 years ago. The great part of the petroleum is delivered by pipe lines, only about 6 per cent. being refined direct at the wells. And here it may be said that the tendency is not to establish works for new wells, but to extend existing works as occasion demands, and convey the petroleum by the most convenient means. Thus the number of works established has not greatly increased in 10 years—from 86 to 94, the latter including 106 separate refineries, while evidence of the growth of the existing works is found in the fact that the capital in the same period has increased 183 per cent. The distillates were treated by various methods according to composition, but principally by the use of sulphuric acid, of which 95,916 tons were used, costing on an average $15.75 a ton. Hydrochloric and other acids and sulphur were also used, although not so largely, accounting for less than 1 per cent. of the acids.

These two items form the greatest part of the cost of production, but the package of the oil absorbs a large item. The total oil refined was 23,770,748 barrels, practically 1,000 million gallons, as against 47¼ million gallons in Britain. The crude oil in the States, therefore, costs about 4.50 cents a gallon refined, while the acids cost .14 cent, fuel .22 cent, barrels, tin cans, packages, etc., .16 cent, while wages absorb .70 cent per gallon. Thus with miscellaneous materials the total cost per gallon works out to about 7 cents; with our shale the cost of production is rather less.

It may be interesting to consider the changes in the items of cost consequent on the changes of 10 years. Details are not given to enable the figures to be worked out in the same way, so that we can only take the percentage of the total cost for both periods. The first point of interest is the marked decrease in the wages cost. Ten years ago 10.03 per cent. of the total outlay was due to wages; now the proportion is 8.22 per cent. A fact distinctly bearing on this change is that the proportion of capital to product is now 91.08 per cent., as against 62.52 per cent. 10 years ago. It can be inferred, therefore, that the use of labor-saving appliances has reduced the labor cost. Certain it is that the wages paid have increased, for while the number of employees has only increased 26.37 per cent., the actual total wage paid has increased 59.52 per cent. Of the workers, 95.58 per cent. are men, three-fourths of whom earn from $9 to $20 a week. Of boys there are 4.14 per cent. Only 35 females are employed, practically all clerks, earning $7.50 a week. Laborers get $1.50 or so a day, tradesmen about $2.25, foremen $3.25, and superintendent $5 a day.

The crude petroleum is much dearer than it was 10 years ago, probably in view of the fact that the stock does not appear so exhaustless as was at one time believed, and it now cost 52.7 per cent. of the total, while 10 years ago it was 37.4 per cent. Be it understood, too, that the ratio of crude oil to finished product has not increased in the same proportion, an indication that either the quality of the raw oil is better, or the refining process more effective. There is no positive evidence. The acids cost less, 1.8 per cent., against 2.55 per cent., but fuel costs about the same—3.35 per cent. Anthracite coal in the form of culm is used largely in the refineries on the Atlantic coast, the cost being $1.75 a ton, as compared with $2.13 for bituminous. Of the residuum used as fuel fully three-fourths, 399,243 barrels, were consumed in the New York refineries. The amount paid for natural gas, $250,000, represents approximately the consumption of 209½ million gallons of crude oil. The manufacture and repair of barrels, tins, and packages show a marked decrease, which again suggests the use of machinery. Ten years ago fully a third of the cost was so absorbed; now 24.79 per cent. is required. Staves, heading, lumber, iron hoops, shooks, etc., cost $8,750,000, and tin cans $5,625,000.

We now come to the product. Owing to the marked differences in the composition of the crude petroleum got in various districts, the resultant products vary, but consist generally of naphthas or the lighter hydrocarbons, illuminating oils, heavy oils or lubricants, and paraffine. In Pennsylvania, for instance, 70.54 per cent. is burning oils, 10 per cent. naphthas, and 8.94 per cent. of lubricating oils, and only 3.24 per cent of paraffine. Again, the crude oil of the Lima district distils a smaller promotion of illuminating oils than Pennsylvania, New York, and West Virginia = 51.64 per cent., with 39.27 per cent. of naphthas, and 7.39 per cent. paraffine. The base of Californian oil is usually asphaltum, while the oil of the Florence field in California gives 32 per cent. of burning oils, but 64.29 per cent. of residuum. Two-thirds is, therefore, as a rule, burning oil, and 12 per cent. naphthas. By way of comparison it may be said that shale as used in Scotland, gives about 35 per cent. of burning oil, 25 per cent. lubricating oil, 10 per cent. paraffine, 5 per cent. naphtha; 25 per cent. being waste products.

As to the aggregate production, it has in point of value nearly doubled, having increased 94.49 per cent., but the cost of materials has increased in like proportion. The greatest increase is in paraffine, which has advanced from 79,465 to 684,849 barrels, an addition of 761.82 per cent.; but in the same time the average value of the barrel has decreased from $5.25 to $4.62. Paraffine wax has almost increased in like proportion = 360 per cent. in respect of value, the output now being 241,951 barrels at $12 each. Naphtha also has increased by 163 per cent.; and here the value has been enhanced from $1.58 to $2.18, so that the production of over three million barrels is the more satisfactory, representing a gain in value of 266 per cent. Burning oils show an increase of 54.22 per cent., to 17 million barrels, but here also the price has decreased from $3.50 to $2.93. Reduced oils have been produced to the extent of 856,730 barrels, an increase of 271 per cent., but the decrease in price gives an addition in value of only 67 per cent. Residuum has increased also to the extent of 421 per cent., and now forms a much larger proportion of the total than formerly.

We have indicated that American oil has an influence on foreign trade; that is demonstrated by the fact that 45.31 per cent. of the production is exported, meaning 10¾ million barrels. Practically the whole of this is burning oil, 60 per cent. of the make being sent abroad. Half also of the paraffine oils refined are exported, the total being 327,196 barrels, and 62.02 per cent. of paraffine wax = 150,052 barrels. The other products exported do not bulk large.

## The Experience of Recent Graduates from Engineering Schools.

The *Engineering News* in critical comment on this subject says:

There is probably no question which possesses quite so much interest to the student in an engineering school during the last year or two of his course, as his prospects for obtaining employment in the line of his profession after graduation. This is especially the case if he is borrowing money or drawing heavily on slim family resources to pay for his engineering education, and this description applies, we believe, to a very considerable proportion of engineering graduates. The literature of engineering is filled with statistics on every conceivable subject of professional importance; but on the highly interesting question of the success and remuneration of the young engineering graduate, the first statistics, so far as we are aware, ever published, have just come to our notice in a paper in the current number of the "Engineering Magazine."

This paper has the suggestive title, "Are We Educating Too Many Electricians?" and its author details the results of a personal investigation of the success attained by recent engineering graduates as follows:

Feeling sure of the overproduction of electrical engineers, and in

*The Experience of Recent Graduates of Three Engineering Schools in Obtaining Employment.*

| | Cornell University. | | | Mass. Institute of Technology. | | | Lehigh University. | | | Total Results. | | | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Electrical. | Mechanical. | Civil. | Electrical. | Mechanical | Civil. | Electrical. | Mechanical | Civil. | Electrical. | Mechanical | Civil. | |
| No. of letters sent. | 35 | 30 | 25 | 46 | 24 | 20 | 27 | 17 | 36 | 108 | 71 | 81 | 270 |
| Per cent. of letters replied to..... | 31.4 | 34.3 | 48 | 69.5 | 33⅓ | 50 | 33.3 | 47.0 | 47.2 | 48.1 | 39.4 | 48.1 | 44.1 |
| Per cent. of those replying who had secured employment..... | 63.6 | 66.6 | 91.7 | 78.1 | 62.5 | 90 | 100 | 100 | 82.2 | 78.8 | 75.0 | 71.8 | |
| Per cent. of those replying who secured employment in line of work for which they studied... | 45.4 | 66.6 | 91.7 | 65.6 | 62.5 | 90 | 88.8 | 87.5 | 82.3 | 65.3 | 71.4 | 87.1 | |
| Per cent. of those replying who had secured employm't through influence of relatives ..... | 18.1 | 0 | 16.6 | 20 | 40 | 0 | 44.4 | 12.5 | 11.7 | 21.1 | 10.7 | 11.1 | |
| Per cent. of those replying who had secured employm't through the influence of friends..... | 0 | 33.3 | 25 | 24 | 40 | 77.7 | 22.2 | 37.5 | 23.5 | 15.3 | 32.1 | 35.8 | |
| Average working day ..... | 8 h. 42 m. | 8 h. 30 m. | 8 h. 15 m. | 8 h. 48 m. | 9 h. 22 m. | 8 h. 34 m. | 9 h. 12 m. | 9 h. 15 m. | 8 h. 34 m. | 8h. 54 m. | 8 h. 56 m. | 8 h. 27 m. | |
| Average pay per week..... | $9.70 | $15.31 | $13.65 | $11.31 | $14.12 | $13.81 | $10.64 | $10.75 | $12.69 | $10.70 | $13.52 | $13.27 | |
| Average rate paid per hour on basis of 5½ working days per week .. | 20.2 cts. | 32.7 cts. | 30 cts. | 23.3 cts. | 27.4 cts. | 29.1 cts. | 21 cts. | 21.1 cts. | 26.8 cts. | 21.8 cts. | 27.4 cts. | 28.5 cts. | |

order to secure some facts as a verification of my convictions, I sent 260 personal letters to the graduates in 1895 in electrical, mechanical and civil engineering from Cornell and Lehigh Universities and the Massachusetts Institute of Technology. The letters were sent in the latter half of September. My idea was to secure statements which would show comparatively the number of positions secured by recent graduates in electrical, mechanical and civil engineering courses, to ascertain whether influence was necessary to secure positions, and, finally, to determine the salaries paid in these positions.

While statistics on these points might not prove anything, they would be a strong indication of probabilities. Of course, it would be more interesting, and possibly more valuable, to have these questions answered by men who graduated from college 10 or 15 years ago, and are well established in the line of work in which they will probably spend the remainder of their lives; but the impossibility of securing such information will be recognized, as men farther advanced in years have much more hesitancy about informing others as to their salaries and occupations.

The letter stated, in brief, that I desired to secure statements from recent graduates in reply to the following questions, the answer to which would be considered confidential:

1. Have you secured a position in the line of engineering since graduation?
2. Was this position secured through any relative?
3. Was this position secured through the influence of friends?
4. Of what does the work you are doing consist?
5. How many hours per day are you employed?
6. What salary do you earn per week?

The replies received were most interesting, courteous and complete. They gave one an opportunity of becoming acquainted with and an insight into the character of some of America's recent and representative graduates in engineering, and the letters would prove valuable and instructive food for consideration by college professors. For example, the letters written by the graduates of one college were particularly noticeable as indicating their authors' lack of training in the use of good English. A number of the letters would make very interesting and helpful reading for young men about to enter the practical life of an electrical engineer. With the consent of the writers, I print extracts from two letters received from graduates in electrical engineering:

"I have made application by letter to about 100 of the leading manufacturing and railway companies, consulting and contracting engineers, etc. Although more than one-half of the letters sent have received kind attention and have been acknowledged, yet, from statements such as this, 'Our engineering force is now filled and more so,' I cannot but think that most of the positions secured must have been created through the influence of relatives or friends."

"After graduation, I wrote a number of letters applying for a position, but received discouraging replies. In these letters I mentioned nothing of shorthand and German. What I wanted was a start in engineering work; this is very difficult as I know from my own case. I then wrote two more letters, in which, among other things, I mentioned my knowledge of shorthand and German, and also stated that I had had some experience in business. Both of these letters brought answers asking an interview. As a result, I have my present position. I believe that technical graduates could more easily obtain positions, if they had something else to recommend them, in addition to their engineering education. Perhaps I would not have a position now, if it were not for my other acquirements,"

The accompanying tables show the tabulated and averaged results of the replies received. There is a table for the graduates from each college, and also a table of the total. In making up these tables, I have tried to be fair and strictly impartial—not a difficult task, as the replies were usually direct and to the point; only in one instance was there a refusal to inform me as to salary.

Considering only the table of total results, which may be taken as a fair indication of the condition of the recent graduates in electrical engineering, it will be found that, while a greater per cent. of the graduates in electrical engineering secure employment, as compared with the other graduates, yet the fewest, relatively, secure employment in the line of work for which they had studied—that is, in order to get employment, they had to take positions in which their electrical knowledge did not count. It will furthermore be noticed that almost twice as many men secure employment in electrical engineering through the influence of their relatives as in mechanical or civil engineering, while about half as many obtain positions through their friends as in the other two professions.

The working day averages about the same number of hours in each profession. Assuming 5½ working days per week, it will be seen that the electrical graduate receives over 20 per cent. less per hour than the mechanical graduate, and 23 per cent. less than the civil graduate, who is best paid of all.

We have studied the table presented by Mr. Floy, the author of the paper above referred to, with much interest, and doubt not that our readers will do the same. The comparison between the experience of graduates from different colleges, which is made in the first nine columns of the table, is hardly of sufficient importance to merit more than a passing comment, as the total number of replies received are too small to draw any conclusions of value as to the relative experience of graduates from either of these three great institutions. But the sum-

mary in the last three columns covers a sufficiently large number of cases to make it worth a careful analysis.

The first noteworthy fact is that Mr. Floy's replies, from which his table is made up, comprise only 44 per cent. of the graduates to whom he sent letters.

Now what are the probabilities respecting the other 56 per cent. who did not reply to Mr. Floy's query? Is it not exceedingly probable that very few of them had secured positions, and that this was, in nine cases out of ten, the reason why no answer was returned? The young man who has a place does not generally hesitate to tell it. It is the one whose many attempts to secure something to do have ended in failure and who feels more or less of mortification over it who is in the mood to resent such a letter of inquiry as Mr. Floy's and omit to answer it. From the figures in the table it appears that of 119 graduates reporting, 90 had secured employment. Suppose that out of the 151 graduates who failed to answer the letter there were 20 who had secured employment, which seems to us a liberal estimate. Then we have a total of 110 out of 270 graduates, or about 40 per cent. as the total securing positions within three months after leaving college.

The question which Mr. Floy's statistics fail to answer is, what becomes of the other 160 men; do they go back to work on the farm or in the store or shop or mill in places where their technical education is of no practical service to them?

If it is indeed true that 60 per cent. of our engineering graduates find no opportunity to put their technical attainments into practice, the matter would be a very serious one. Granting all the benefits of a broad engineering education in enlarging a man's mind and character and broadening his mental horizon, these benefits may be purchased at prices which few young men starting out in life can afford to pay, unless some financial gain is ultimately to result.

We do not believe, however, that so large a proportion of engineering graduates or anything like so large a proportion fail, permanently, to find positions in which their technical knowledge is brought into play. It must be remembered that the industries which employ engineers are carried on to make money, not to furnish employment. Vacancies occur or new men are required on account of expanding business at a fairly regular rate throughout the year. The influx of a thousand or more graduates, which are turned out in June of each year from the technical schools, cannot possibly be absorbed at once. That 40 per cent. of these men should have salaried positions within three months of graduation is a remarkably good showing, rather than a remarkably poor one. We doubt not that during the remaining nine months before the class of 1896 is in the market for positions, a goodly proportion of these 160 men which we have supposed still wanted positions in September last, will have found them.

Of course, in every year's output of the schools, there are some men who, from personal deficiencies of one sort or other, or merely from preference, never take up any line of active industrial work. There will be more or less of these even in the best of times; for in every engineering school there are those who pursue the full course of study and take their diplomas who have no natural fitness for engineering or for the industrial pursuits allied to it.

A feature of Mr. Floy's table of quite as much interest to the young engineer as the percentage of graduates securing employment, is the average salary received. From the student's point of view it is eminently discouraging that after completing an expensive education, ending with four years of hard study at the best engineering schools of the world, a man should have to take a place at $2 per day and count himself very fortunate to get that.

But there is another point of view. Is it not rather remarkable that with over a hundred engineering schools turning out men with excellent training every year, and when it has become so easy for a young man to secure such a training, the supply of such men should not be so far in excess of the demand as to force salaries down much farther than is actually the case?

Let us make some comparisons. A boy of 17 or 18 may get a position in an office or store at $5 to $8 per week, and four years later his pay may be $10 to $15. During that four years he will be learning some business routine and little else; and what is most important, he can look forward to no very considerable increase as the years go on. We are speaking, of course, of average results, in the case of youths who have only their own efforts to rely upon. If the same youth learns a trade he will spend three years as an apprentice, and at the end of that time will be doing well if he earns as a skilled workman $15 a week the year round; with nothing higher to look forward to at best than a place as a foreman.

The same youth, if he have the requisite natural abilities, can spend four years at an engineering school, and at the end of that time can begin his life work at nearly as large wages as a brother who learned the machinists' trade, or another who entered a store will then be receiving; but with this large difference that the man with the engineering education has been so developed and broadened that he can look forward to filling positions of greater responsibility and greater compensation as the years go on. Four years of time and a pecuniary investment of $1,200 to $2,000 probably represent the cost of the average engineering education. We believe few graduates will deny that their investment of time and money has been on the whole a profitable one.

It will be seen from our quotation above from Mr. Floy's paper that he deduces from his statistics the conclusion that there is a greater overproduction of electrical engineers than of graduates from courses in civil and mechanical engineering. He says the civil engineering graduate is the best paid of all, averaging 23 per cent. higher pay than the electrical graduate. But he fails to point out the fact that the young civil engineer—or the older one, for that matter—has to accept positions which are seldom permanent, and which generally furnish employment for only a year or two at longest. In view of this fact, it can hardly be considered that the pay of the civil graduate is on the whole any higher than that of his electrical brother. In fact, if full weight is given to the uncertain duration of civil engineering work and its intimate dependence on general industrial conditions, it would probably be found that the electrician is considerably the better off of the two, so far as his first salary returns are concerned.

We are far from arguing from this, however, that the electrical graduate has, on the whole, the better ultimate chances of good success. On the contrary, Mr. Floy's statement that the popular craze on all matters electrical is resulting in turning far too many young men toward the study of electrical engineering is doubtless correct.

The most notable defect in American engineering schools to-day is probably the tendency to specialize, to make the students competent workmen in some particular lines rather than broadly capable in all lines. We are aware that the pressure is strong in this direction, and that the schools are being constantly urged by parents, pupils and employers to turn out skilled draftsmen, transitmen, computers, electricians. There is, indeed, much to be said in favor of a course of study which enables a student to do some one thing well enough to earn his living by it as soon as he leaves his studies; but that is after all the least valuable of the benefits which a technical education confers. The student whose training is so broad that he can take up any department of engineering and gain by himself the special knowledge to make him proficient in it, is the man who gains most from his college course and is most able to fill successfully those highest executive positions which are the best rewards to which members of the profession aspire.

## SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, January 10th, 1896.

*Gas Fires and Ventilation.—Progress of Electric Lighting.—The Coal Trade.*

Public attention has been prominently attracted to the so-called "danger" of using gas in sleeping rooms, by the decease of the pastor of a well-known chapel in London, and the serious illness of his wife, (who is not yet out of danger) which was caused by circumstances about to be detailed. The unfortunate gentlemen, who was the occupier of a flat in a West End mansion, had a great objection to draught and fitted his doors and windows with excluders. An ordinary register grate was provided in his bedroom, and in front of this he had placed a gas fire of the usual pattern, from a well-known maker. There was the usual connection for flue pipe at the back to which was attached an elbow and a long upright pipe passing through the chimney, which was tightly closed in every other respect by means of an iron plate, cut to fit the register opening. Not being in good health, the reverend gentleman and his wife gave orders, when retiring as usual, that they were not to be disturbed until they rang the bell. The servants left them alone all through the forenoon of the next day, but a friend who called in the afternoon suspected that all would not be right, and undertook to try and rouse them. Finding no response to the repeated knockings, he opened the door of the bedroom. The gas fire was burning, the air felt hot and dry and the occupants lay unconscious in bed. Every possible remedy was at once applied, but unsuccessfully in the case of the pastor, who never recovered his health, and died about three weeks afterwards. No notice appears to have been taken of the gas fire at the time, but a few days later it was observed that the flue pipe and elbow had fallen away from the connection at the back. The elbow had dropped into the grate, and the upright pipe still filled the aperture made for it. Under these conditions the whole of the products of combustion would escape into the room, and the presumption is that the elbow was detached during the evening, or fell off in the night.

So far the surroundings of this unfortunate occurrence are plain, but

are not properly appreciated by the general public, who imagine that the accident was caused by some pernicious property of the gas fire. They do not realize that a coal or coke fire under similar circumstances would have proved equally fatal. The truth is that the reverend gentleman was a victim to a very common delusion on the subject of ventilation. How often we find a perforated plate or a little flap door, which is said to be a "ventilator." The deceased gentleman, who had taken degrees at college, evidently supposed that the flue pipe was a "ventilator," and would secure the air of his bedroom against becoming vitiated or foul. Nature abhors a vacuum, and foul air will not go out of a room unless there is provision for the entrance of fresh air. Nor is it evident how poor mortals would be assisted if it would, for foul air is better than no air at all. Many people seem to suppose that ventilation is a sum of one factor, viz., to let the used air out. They are not aware that the admission of fresh air is of equal importance.

When we consider the large number of gas stoves that are used, both for cooking and heating, and the fact that many of these are fixed without any attention to their effect on the question of ventilation, there is reason to wonder that accidents are not more frequent. Very strange ideas, also, seem to prevail on the question of gas fires and ordinary chimneys. A tube of 3 or 4 inches in diameter is the proper-sized outlet for the products of combustion from a gas fire. If made of non-conducting material, it allows the burnt air to remain hot enough throughout its whole length to create the necessary up draught. But this condition cannot obtain if the gas fire is connected to a large rectangular channel of 200 or 300 square inches area, through which the whole affair could be pulled, with a few inches to spare. This is a fair description of many domestic chimneys, and under such circumstances the up-draught is apt to be checked and stopped altogether. The products of combustion become cooled to such an extent that instead of being lighter than air they are heavier. A chimney can be as effectually closed by a plug of cold products of combustion as by a bag of shavings. I have repeatedly seen instances where the front of the grate was closed with an iron plate, a hole cut out to receive the flue, and the gas fire fixed flat against it. This arrangement looks nice, but after awhile the occupiers say they do not like the gas fire. The room is so close and stuffy, and they suppose the chimney breast ought not to be filled up. The real reason is that the chimney is blocked up more or less completely by the means just noticed, and the products of combustion escape into the room. Make a small hole in the iron plate near the hearth, or probably a crack will be found there, sufficient for the purpose. Hold a lighted match to the opening. If there is a proper up draught the flame will be pulled in. Sometimes the flame is not drawn at all, or perhaps it is extinguished by a down draught. In the latter case the sooner the gas fire is taken away the better for everybody, gas company included. If the user of the gas fire is an intimate friend, and keeps a good brand of cigars, one may be borrowed for the purpose of illustrating the above experiment.

I have just come across an interesting article on the progress of electric lighting during 1895, in the columns of a daily paper. In such a place it has of course been written with a purpose. It is evidently the work of parties commercially interested in electric lighting, as its purport is to expose "the very remarkable ignorance of the public on this matter." This ignorance, in the view of the authors, is illustrated by the result of a recent election in an important London parish. Three candidates presented themselves for the one vacancy, two of which made opposition to a proposal for the adoption of an electric lighting scheme, a leading point in the programme. One of these was the successful candidate, who was returned by a large majority, and had declared that he undertook the contest on this question. He considered the electric light to be a costly luxury and a complicated venture, that a committee of vestrymen could not possibly know anything about it, and further, that they had quite enough to do without this new and doubtful undertaking. These opinions seem to be regarded as calling for refutation, and accordingly the working results of several undertakings worked by municipalities, as shown by the latest Board of Trade returns, are labored at considerable length, with a view of proving that no public official need hesitate about supporting any electric scheme, and that it is as much the duty of a Corporation to supply pure light (at a profit, of course) as pure water.

But there are two sides to this question, and like the matter of ventilation, only one of them appears to receive attention. The first depends upon the degree of commercial success that has attended the adoption of the electric light, and there is no reason why general ignorance should exist on this point. Neither electricity nor electricians belong to the class that are born to blush unseen. Every success attained has been largely advertised. If used at all it is not condemned to the back or the basement, but is used in the front and the principal parts of the tenement where everybody can see it. So there is no reason whatever for supposing that the public are not sufficiently posted as to the progress of the electric light. But the second point goes further than this. Admitting for the moment that the electric light is the success all along the line that the authors would have us believe, it does not follow that the municipal authorities are the best qualified to deal with it, or that they are able to meet the public needs with more acceptation than private individuals or companies. There is something very different from absurdity in the opinion that vestrymen cannot be expected to know anything about it, and that they have quite enough to do without it. Municipal management of such old-fashioned commodities as gas or water supply is not always an unqualified success, so a cautious policy in regard to more modern refinements is not altogether reprehensible.

In addition to the Board of Trade returns, interviews were held with "a prominent official at St. Pancras" (a London parish where a municipal electric lighting undertaking is in operation), and with Mr. W. Preece, Chief Electrician at the Central Post Office. And here it is evident that the writer's desire, not only to reassure the public as to the progress of the electric light, but to show that no other interests are threatened. Electricians have not been satisfied with hawking their own wares, but from the first have made a dead set at gas. They have little or nothing to say about petroleum or candles, but never fail to improve the occasion, from their particular field of operations, with regard to gas. And so we find the anonymous "official" expressing the opinion that incandescent gas light will not check the development of electricity. Mr. Preece does not quite agree with this view. He thinks it may do so for a time. This is a point upon which people will prefer to form their own conclusions. Mr. Preece was tackled by the interviewer with an extract from one of his reports, which set forth that gas interests had been benefited wherever the electric light had been introduced, and asked to explain his meaning. The reply was that it had stirred up gas companies to greater exertion and increased the demand for light. He also stated that he saw no probability of gas being superseded by electricity for working purposes, and that the companies had nothing to fear in that direction.

The article would of course be incomplete without a reference to the future of electricity, which is the favorite theme of electricians. They are big on the present developments and on the evils of gas, but simply immense when they get to the possibilities of the future. So the concluding paragraph is a great flourish of promise for the time to come. Mr. Preece "has unbounded faith that the electric light will gradually get cheaper and cheaper. Patents are expiring, experience is growing and manufacture is improving." This sanguine disposition is enviable, as it frequently serves as a consolation for the failures of the present. Whatever the intrinsic value of electricity as a lighting agent may be it seems to need a great deal of extraneous puffing in one form or another.

No one appears to have seen reason for attempting a popular summary of the progress of gas lighting during the year. Yet, a great deal could be said on this subject. The most marked feature has been the activity in the incandescent gas burner line. Then there has been a rapid extension, especially in London, in the placing out of prepayment meters for small consumers, in conjunction with a cooking stove and two or three gas lights fitted gratis. Something might also be said on the introduction of "processes" for producing gas from materials other than coal, such as coke or petroleum, by means of which the principal gas companies have rendered themselves quite independent of the cannel coal merchants, and have also opened up a good outlet for surplus coke. Then there is acetylene hovering in the back ground, though its advocates appear, like the electricians, to dwell as much on the probabilities of the future as on the actual realities of the day. Well, we must be thankful we are alive and doing well up to the present moment (7 h. 18 min. 40 sec. P.M.)

The condition of the coal trade during the past year, while favorable to users of large quantities, has not been satisfactory to proprietors of mines, who complain that prices are now cut so low as to leave no margin for a profit, and that many pits are kept open at a loss. A peculiar feature about the coal trade is, that there is always somebody in the ditch. A little while ago it was my duty to chronicle the fact that the high price of coal was a serious incubus to gas companies and, of course, manufacturers in general. Since then the miners have claimed to occupy the anomalous position of not receiving a living wage. And now the proprietors are underneath. Gas companies have not secured the full benefit that might be indicated by this state of things, as the prices of gas coals have not fallen so low as the steam and

household coals. The demand for gas coal is more steady and regular, not being directly influenced by the weather or condition of trade, and they are usually sold at contract prices extending over twelve months, thus rising clear of the fluctuations that attend spot selling from week to week. The present position is a natural reaction from the high prices of a year or two since. High prices may be a direct benefit for the time being, but they attract competition both at home and abroad. The strikes and labor disputes had the effect of directing trade into other channels, and once driven away it is difficult to get it back. But one of the chief causes of the present lack of profits is the fact that it is a common practice not to work the mines full time.

The output is limited according to the demand, which actually means a diminution in productive capacity without a corresponding reduction in the capital and the working charges. Every working hour wasted goes to increase the actual cost of coal mining, and the most promising opening for improvement seems to be the abandonment of this retrograde policy. If there is not enough for 100 mines to do, shut 10 of them, and the 90 will supply the demand with a considerable economy in working. While other traders are struggling to increase the productive capacity of their plant, coal owners must do the same. Various schemes for forcing prices have been tried without success, and the miners will not accept less wages. In the absence of any other solution the problem will be settled by the weaker collieries going to the wall.

## ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THERE is some probability of the establishing of a gas works at Elkton, Ky.

AT the annual meeting of the Macomb (Ills.) Gas and Electric Light Company the following officers were elected: Directors, Jos. W. McIntosh, I. N. Pearson, George W. Bailey, J. W. Wyne, E. A. Lane, I. M. Fellheimer and H. W. Cummings; President, Jos. W. McIntosh.

CITY TREASURER J. P. EDMONDS, of Lansing, Mich., reports that the receipts of the city, from the operation of the new franchise agreement between it and the Lansing Gas Company, amounted to $1,034.20; which sum represents 5 per cent. of the Company's gross receipts.

MR. BUCHANAN R. BURBANK, Superintendent of the Vineland (N. J.) Gas Company, died on the 13th inst. Mr. Burbank was born in Shelburne, N. H., May 25th, 1837, and in time graduated from the Bethel (Me.) Academy. In 1859 he removed to Wakefield, Mass., and in 1866 he was appointed Superintendent of the Citizens Gas Light Company, which supplied gas in the towns of Wakefield, Reading and Stoneham. In January, 1894, he took charge of the Vineland (N. J.) Company's works. Interment was made in Wakefield.

THE annual meeting of the Newport (R. I.) Gas Light Company was in all respects harmonious and satisfactory, the annual reports demonstrating that the doings of the Company for the past year more than equaled the expectations of the proprietors. The officers chosen were: Directors, James C. Swan, Melville Bull, Andrew K. Quinn, Henry Bull, Philip Rider and Thomas A. Lawton; President, Henry Bull; Secretary, Thomas A. Lawton; Treasurer, Andrew K. Quinn.

A CORRESPONDENT forwards the following: "The annual meeting of the stockholders of the Gas Company, of West Chester, Pa., was held on the 13th inst. The Directors elected were: Col. Edward Worrall and Messrs. Charles T. Audenried, Henry V. Massey, Wm. G. Thomson and Thos. P. Worrall. The management submitted to the stockholders a report of the year's business, which, among other things, showed that the Company, during the year 1895, sold 14,306,800 cubic feet of gas, as against 13,497,400 cubic feet in the year 1894. The report further set forth that when the new management took hold of the West Chester gas plant, Jan. 1, 1893, that the sales for the preceding year (1892) had been in round numbers but 10,000,000 cubic feet. This exhibit shows that under the new management the sales of gas have increased 43 per cent. The report also notes that the Company has at this time 850 gas stoves in use, and is supplying power to 4 gas engines and to 6 linotype machines. After the stockholders' meeting adjourned, a meeting of the Directors was held, and the following named gentlemen were elected to fill the offices of the Company for 1896: President, Thomas P. Worrall; Treasurer, Chas. T. Audenried; Secretary, Henry V. Massey; Superintendent, J. J. Humphreys, Jr.; Cashier, Lewis R. Dutton. The Company suffered loss by fire in February, 1895, and erected, at a cost of several thousand dollars, a fireproof brick and iron generator house, which has been paid for out of the earnings for the year. In addition to this, extensions have been made to the main system and a large number of new house services added. The Company's mains now run under more than 12 miles of the streets of West Chester."

AT the instance of Ald. John Coughlin the following ordinance, typical of that precious collection known as the Chicago Board of Aldermen, was introduced:

"An ordinance regulating deposits of money to secure payment of gas bills: Be it ordained by the City Council of the city of Chicago:

"Sec. 1. That hereafter it shall be unlawful for any person, firm or corporation engaged in the business of furnishing illuminating or fuel gas for consumption in the city of Chicago to require or receive any deposit of money or other valuable article as a condition precedent to or as security for furnishing the same.

"Sec. 2. Whenever any person, firm or corporation in said city shall require illuminating or fuel gas, he, they or it shall apply to any person, firm or corporation whose business it is to supply gas of the quality desired and whose gas mains are located in the street or alley adjoining the premises upon which such gas is required, whereupon the party so supplying gas shall estimate as nearly as may be, either by some method to be hereafter devised, or by some rule or method now in vogue, or by the statement of the first monthly bill, the quantity of gas which such applicant would be expected to consume a month, and shall estimate the value thereat, the then current rate of charges therefor, and shall certify the same to such applicant, whereupon such applicant shall deposit with the City Treasurer of the city of Chicago the sum so estimated, taking such Treasurer's receipt thereby issued in duplicate, and shall deliver to the party so furnishing the said duplicate receipt, and thereupon it shall be the duty of such party so furnishing gas to place a meter, make all necessary connections, and furnish gas to such applicant.

"Sec. 3. Whenever any person, firm or corporation who has made a deposit of money with the City Treasurer as aforesaid desires to discontinue the use of such gas he, they or it shall notify the party so furnishing the same of such desire, and shall pay all monsy due for gas theretofore furnished, and shall demand and receive a receipt therefor as in full of the same, and upon presentation of the same, together with the original deposit receipt, shall receive from the said City Treasurer the amount of said deposit with unpaid accrued interest thereon.

"Sec. 4. Deposits of money made with the City Treasurer under the provisions of this ordinance shall bear interest at the rate of 5 per centum per annum, payable semi-annually.

"Sec. 5. Nothing herein contained shall be construed to require any person, firm or corporation engaged in the business of supplying gas, to furnish to any consumer any more gas than would be paid for by the amount of the aforesaid deposit before the same shall be paid for by such applicant, but such deposit shall be treated as a security for the payment of gas furnished to such applicant to pay for the same. The City Treasurer shall pay the amount thereof to such party furnishing gas upon presentation of such duplicate receipt and satisfactory proof of the amount of gas furnished. Whenever it shall be found such deposit is too small to furnish the security contemplated, the same shall be increased and new certificates of deposit issued. Any person or persons in arrears with any corporation for furnishing illuminating gas or fuel gas shall be required to deposit not less than $10 nor more than $50."

AT the annual meeting of the Kalamazoo (Mich.) Gas Light Company the officers elected were: Directors, C. A. Peck, J. J. Knight, J. W. Thompson, I. A. Ransom and E. Woodbury; President, I. A. Ransom; Secretary, E. Woodbury.

PAPERS certifying the incorporation of the Washington Gas Company, of Washington, Pa., have been filed. The capital is put at $50,000.

MESSRS. READ & PETTIT, acting as Solicitors for Allan B. Rorke, Francis Gordon Bates, George H. Holgate, Edward C. Quin and Clay Kemble, notify all whom it may concern that they will, on the 28th inst., apply to the Governor of Pennsylvania "for the charter of an intended corporation, to be called the Philadelphia Fuel Gas Company, the character and object of which are the manufacture and supply of gas, for fuel purposes only, to the public at the city of Philadelphia."

MR. D. J. BISSELL has been elected President of the Le Roy (N. Y.) Gas Company. The Vice-President of the Company is Mr. A. D. Bissell.

THE stockholders of the Peoples Gas Light Company, of Jersey City, N. J., have named the following Board of Directors: T. Morris Perot, Thomas H. Williams, Freeman A. Smith, H. A. Coursen, Frank Stevens, Hamilton Wallis, John J. Voorhees, George W. Conklin and Stephen H. Plum; President, T. Morris Perot; Vice-President, Thos. H. Williams; Secretary and Treasurer, E. R. Case. Mr. Case is evidently the right man in the right place, for he has served the Company as its Secretary and Treasurer since 1880.

THE Berlin Iron Bridge Company, of East Berlin, Conn., has just completed for the Ansonia Brass and Copper Company, of Ansonia, Conn., a new boiler house, 65 feet wide and 142 feet long. The side walls are of brick, and the roof is entirely of steel, covered with the Bridge Company's corrugated material.

IN our mention two weeks ago of the betterments that had been made, under the direction of Supt. Runner, on the plant of the Freeport (Ills.) Light and Fuel Company, we said that a new 6-inch street main governor, of the Connelly type, had been put in place. The real dimension of the governor, however, is 12 inches instead of 6 inches.

WE understand that Mr. Kean, the proprietor of the Elizabethtown (N. J.) Gas Light Company, intends to fire up the plant of the Metropolitan Gas Company, of Elizabeth, which property came into his hands through purchase under foreclosure proceedings, when the backers of the Metropolitan opposition concern gave up their losing contest.

GOVERNOR COFFIN has appointed Mr. William G. Mixter, of New Haven, State Inspector of illuminating gas and gas meters. His term of office is to be for three years.

MR. ROBERT CHALMERS, for 26 years in the employ of the North Attleboro (Mass.) Gas Company, is dead. He was in his 58th year.

MR. A. FYFE HALL has been appointed Superintendent of the Southbridge (Mass.) Gas and Electric Company, vice Mr. Alexander McLean.

A CORRESPONDENT forwards the following from New Haven, Conn., under date of the 17th inst.: "Mr. John Coyle has voluntarily resigned his position as foreman of the Norwich City (Conn.) Gas Company. He had been with the Company since the works were built—in fact, he assisted in their construction, which means a service of 44 years. On the day that his resignation took effect the employees of the Company presented him with a handsome easy chair, which the veteran donee, in accepting the remembrance, said would enable him to take it easy during the remaining days of his life."

"OBSERVER" encloses the appended mention: "At a meeting of the Directors of the Pawtucket (R. I.) Gas Company, held for the purpose of electing a President to fill the vacancy occasioned by the death of the Hon. Lucius B. Darling, the Board unanimously named Mr. Lyman M. Darling, a brother of the deceased, to the position. The appointee has served for a number of years on the Board of Directors. The selection is not only regarded the best that could be made, but is also looked upon as a tribute to the memory of the late President."

THE Winfield (Kas.) Gas Company it is said has agreed to accept the ordinance passed by the City Council of that place, putting the net rate for gas used for illuminating purposes at $2 per 1,000 cubic feet. No change is made in the rate for fuel gas, which remains at $1.50 per 1,000. Consumers who do not use 200 cubic feet each month will have to pay an additional charge for meter rental of 25 cents.

MR. L. W. GOULD has been appointed Superintendent of the Vineland (N. J.) Gas Works, vice the late Mr. B. R. Burbank. Mr. Gould has been for some time Treasurer and Purchasing Agent of the Company.

AT the annual meeting of the Williamsport (Pa.) Gas Company the following officers were elected: Directors, John M. Dean, John F. Ladlein, H. H. Pigott, R. C. Reading, John G. Reading, Jr., H. Mudge, B. C. Bowman; President and Superintendent, R. C. Reading; Secretary and Treasurer, George E. Rentz; Assistant Superintendent, M. J. Winters; Solicitor, John G. Reading, Jr.

THE increase in the sendout of the Terre Haute (Ind.) Gas Light Company, under the new proprietorship, has been sufficient to induce Superintendent Diall to fire up the generating plant of the Citizens Gas and Fuel Company, which works were shut down when the consolidation of the gas interests of Terre Haute was perfected some months ago.

THE proprietors of the Burlington (Iowa) Gas Company have ordered a reduction in the selling rate to $1.50 per 1,000 cubic feet.

THE Common Council of Pawtucket, R. I., at the instance of Mr. Brown, recently adopted the following: "*Resolved*, That the joint standing committee on street lights be and are hereby directed to inquire as to the quality of the gas now furnished by the Pawtucket Gas Company, and to ascertain how it compares in quality with the gas sold in other cities, and whether the price charged here is higher than in other cities where similar gas is used, and to report what legislation is necessary to enable the City Council to control the quality of gas furnished and to be furnished, and the price at which it should be sold."

PUTTING the Hillsdale (Mich.) Gas Company in the hands of a Receiver does not seem to have ended its turmoil, for the press reports of something over a week ago report the happening there of an explosion in the purifying room, which did considerable damage. Luckily no personal injuries were occasioned, although Engineer Henry Canfield had a narrow escape.

THE executive management named by the Iowa City (Iowa) Gas Light Company is as follows: President, T. C. Carson; Treasurer, Max Meyer; Superintendent, Daniel Davis. The Company is prospering, and the likelihood is that a sensible addition to the main system will be made this season.

THE plant and franchises of the Fort Madison (Ia.) Gas Company were sold at foreclosure sale about a fortnight ago, to satisfy a judgment for $50,000 obtained by the Northern Counties Investment Trust, of England, who was trustee for the bondholders. The property was bid in by Mr. James C. Davis, Attorney for Elijah Coffin, of New York, who acted for the bondholders. The bid price was $20,000. It is likely that Col. McCray, who has acted as Receiver of the Company for some time, will remain in control for the purchasers. We further understand that the plant will be enlarged and improved this season, and that a new purifying house and suitable equipment therefor will be erected at once.

AT the annual meeting of the Akron (O.) Gas Company it was determined to order a reduction of 10 cents per 1,000 cubic feet in the selling rate. The Company will also expend this season a large sum of money ($100,000 or more) in plant betterments, the scheme for which includes a storage holder and several miles of mains. The distributing system is to be extended to the outlying settlement of North Akron.

THE Council of Marietta, Ga., has granted a franchise for the operation there of a gas works to the United Wood Gas Company, the projectors of which concern are said to be the residents of this city.

MR. BETTS, President of the Wilmington (Del.) Coal Gas Company, denies positively that he is or has been negotiating with Mr. J. Edward Addicks for the sale to the latter of a controlling interest in the Wilmington Company.

THE Point Breeze Station of the Philadelphia municipal gas works has been equipped with two charging machines of the Bronder improvement on the Ross steam stoking apparatus.

THE annual election in the Middletown (N.Y.) Gas and Electric Light Company resulted as follows: President, Albert Bull; Vice-President and General Manager, L. C. Purdy; Treasurer, C. Macardell; Secretary, G. T. Townsend.

THE last or current dividend of the Louisville (Ky.) Gas Company is at the rate of 5 per cent. per annum, a cut of 1 per cent. per annum.

IN the case of the Consolidated Gas Company, of Baltimore, Md., against the Hoyt Meter Inspection Company and William B. Hoyt, Judge Dennis, of Circuit Court No. 2, on the 17th inst., passed a decree perpetually enjoining the defendants from moving, disturbing or in any way interfering with the meters and connections of the plaintiff; and also from making any connections with the said meters and connections. In our report of the preliminary injunction proceedings, it was said that the Hoyt Inspection Company was engaged in making, by permission of consumers of gas, private examinations or tests of gas meters, with the purpose of determining whether or not the meters were registering correctly, and the Gas Company objected on the ground

(*Continued on page* 135.)

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(*Continued from page* 134.)

that the interference was at once illegal and unnecessary; further, that defendant's workmen were neglectful in restoring the connections to the point of allowing the same to remain in a leaky condition.

THE Columbus (Ohio) *Press* of the 19th inst., in editorial mention of the public street lighting experiment by gas used in Welsbach burners, says: "There is no doubt, if the lighting of the sidewalks as well as the center of the roadway is taken into consideration, the Welsbach gas lights, as operated on Broad street between Third and Sixth streets, makes the most perfect and uniform illumination yet devised. It is said streets can be lighted for about 33 per cent. less by this mode than by electric lighting."

THE Board of Aldermen, of Decatur, Ills., have refused to entertain the proposition for the granting of an opposition gas ordinance for that city.

AT the annual meeting of the Dover (N. H.) Gas Company the following result was reached: Directors, Amos Paul, Charles H. Sawyer, John Holland, Eli V. Brewster and Thomas B. Garland; President, E. V. Brewster; Secretary and Treasurer, Thos. B. Garland.

THE Committee on County Buildings, of the Fond du Lac (Wis.) County Board, has authorized the local Gas Company to light the public buildings, the rate for the service to be $1.75 per 1,000 cubic feet.

THE residents of Kingston, Mass., favor the construction of a gas works at that point.

AT the annual meeting of the Bristol (R. I.) Gas Light Company the following officers were chosen: Directors, H. W. Church, R. S. Franklin, W. T. C. Wardwell, J. C. Swan and J. Howard Manchester; President, H. W. Church; Secretary, Treasurer and Superintendent, J. Howard Manchester.

THE stockholders of the New Orleans (La.) Gas Light Company have named the following Directors: A. H. Sieverd, R. M. O'Brien, Jas. Jackson, Alden McLellan, F. T. Howard and A. Baldwin.

AT the regular annual meeting of the stockholders of the Brooklyn Firebrick Works the following gentlemen were chosen to act as Directors for the present year: A. H. Gutkes, Edward D. White, David H. Valentine, Seth L. Keeney, Wm. Beard, Frederick T. Aldridge, Daniel J. Creem. At a subsequent meeting of the Directors the officers elected were: A. H. Gutkes, President; Edward D. White, Vice-President; Frederick P. Morgan, Secretary. The regular semi-annual dividend of 3 per cent. on the capital stock was declared out of the earnings. This is a very good showing considering the general depression in manufacturing lines, and speaks well for the capable and efficient management of the Company's affairs.

## Gas as a Motive Power for Vessels.

Besides the petroleum motor, the gas motor is beginning to come into use as motive power for smaller coast and river vessels. One of the first steps in this direction was done by the company "La Seine Maritime," which ordered a number of gas motors for its vessels from D'elamare, Deboutteville and Malandin, Paris, in order to establish a freight line on the Seine river between Havre, Rouen and Paris. The firm mentioned had constructed in 1883 already a tricycle provided with a gas motor, which proved very satisfactory. The new motor belongs, like the old one, to the simplex type, but it is standing upright. It is run with illuminating gas, which is furnished to the vessels of La Seine Maritime by a small gas factory erected between Havre and Paris. The plant keeps always a supply of gas in a reservoir constructed of steel pipe under a pressure of 95 atmospheres, which is led to the vessels by means of a flexible tube. The iron vessel "Idee" is the first of its kind. It was built in the establishment of Mallard, at Rouen, is 120 feet long, 16½ feet wide and draws 6¾ feet of water. It consists of four waterproof compartments. The first one, at the bow, serves the needs of the crew, the second and third, occupying four-fifths of the whole length of the ship, are destined for the freight, while in the last, at the stern, the motor is placed. The vessel is of 300 tons beutto capacity, and can carry a cargo of 250 tons. The gas supply on board is stored in an accumulator constructed of steel pipe about 9 inches diameter, ½-inch strength of wall and 15 feet length, and is compressed usually to 95 atmospheres.

## The Market for Gas Securities.

The legislative proposed grind is still at work, the latest contribution to the hopper being a measure to prevent the consolidation of gas companies in this State. We will have more to say about it later on. Consolidated was dull and weak in the interim of writing, sales having been made as low as 144, but yesterday (Thursday) a better feeling prevailed, and the figure of 146¼ was reached. The opening today was 145 bid, offered at 147. Equitable is somewhat higher, the bid rate having been advanced to 199; it is offered at 202½. Mutual virtually remains unchanged, as do Standard common and preferred and the East River issues. We note a sale at auction of 100 Standard preferred, at 106. The situation in Brooklyn presents no new features. The consumers are giving vigorous expression of disapproval over the lack of quality in the gas supplied to them, and a fair quotation for shares in the Brooklyn Union Company is 75 to 77. At auction 125 shares of original Nassau stock brought 384. A suit that is attracting much attention in gas circles is that brought by Mr. E. C. Benedict, who asserts that his desires in regard to 2,000 shares of stock in the Williamsburgh Gas Company held by him, and which were to have been treated by the people who engineered the Brooklyn combination after the manner in which their own holdings were to be treated, were disregarded. He also claims that certain commissions paid to the active organizers were not legal. The case is now in the United States Circuit Court, and its progress will be watched with interest. The final legal proceeding to determine the right of the Chicago Gas Companies to combine has been instituted, and springs from the refusal of the Secretary of State to issue a certificate of incorporation recording the bona fide amalgamation of the Chicago, the Peoples, the Consumers and the Equitable Companies under the title of the Peoples Consolidated Gas Light and Coke Company, of Chicago. A mandamus has been applied for to oblige him to issue the certificate.

Consolidated, of Baltimore, is weak, at 55 to 56, and Western, of Milwaukee, is also dull, at 63 to 65. Bay State shows no particular change.

## Gas Stocks.

**Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.**

35 WALL ST., NEW YORK CITY.

JANUARY 27.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

| *N. Y. City Companies.* | *Capital.* | *Par.* | *Bid.* | *Asked.* |
|---|---|---|---|---|
| Consolidated | $35,430,000 | 100 | 145 | 147 |
| Central | 800,000 | 50 | 150 | .. |
| " Scrip | 220,000 | .. | 100 | . |
| Equitable | 4,000,000 | 100 | 199 | 202½ |
| Bonds, 6's | 1,000,000 | 1,000 | 105 | .. |
| " 1st Con. 5's | 2,300,000 | 1,000 | 114 | . |
| Metropolitan Bonds | 658,000 | .. | 108 | 112 |
| Mutual | 3,500,000 | 100 | 219 | 224 |
| " Bonds | 1,500,000 | 1,000 | 100 | 102 |
| Municipal Bonds | 750,000 | .. | .. | |
| Northern | 150,000 | 50 | 79 | 80½ |
| " Bonds | 150,000 | 1,000 | .. | 98 |
| New York and East River | 5,000,000 | 100 | 32½ | 34½ |
| Preferred | 2,000,000 | 100 | 67 | 73 |
| Bonds 1st 5's | 3,500,000 | 1,000 | 97 | 99 |
| " 1st Con. 5's | 1,500,000 | .. | 88 | 86 |
| Richmond Co., S. I. | 348,650 | 50 | 50 | .. |
| " Bonds | 100,000 | 1,000 | .. | .. |
| Standard | 5,000,000 | 100 | 66 | 68 |
| Preferred | 5,000,000 | 100 | 103 | 106 |
| Bonds, 1st Mortgage, 5's | 1,500,000 | 1,000 | 107 | 110 |
| Yonkers | 299,650 | 50 | 112 | .. |
| *Out-of-Town Companies.* | | | | |
| Brooklyn-Union | 15,000,000 | 100 | 75 | 77 |
| " " Bonds (5's) | 15,000,000 | 1,000 | 104½ | 105 |
| Bay State | 5,000,000 | 50 | 20 | 23 |
| " Income Bonds | 2,000,000 | 1,000 | .. | 30 |
| Boston United Gas Co.— | | | | |
| 1st Series S. F. Trust | 7,000,000 | 1,000 | 78 | 80 |
| 2d " " " | 3,000,000 | 1,000 | 54 | 55 |
| Buffalo Mutual | 750,000 | 100 | 125 | .. |
| " Bonds | 200,000 | 1,000 | 95 | 100 |
| Central, San Francisco | 2,000,000 | .. | 95 | .. |
| Chicago Gas Co. | 25,000,000 | 100 | 64¾ | 64¾ |
| Chicago Gas Lt. & Coke Co. | | | | |
| Guaranteed Gold Bonds | 7,650,000 | 1,000 | 94 | 94¼ |
| Columbus | 1,000,000 | .. | 66¼ | 67 |
| 1st Mortgage | 1,065,000 | .. | 94 | 95 |

| | | | | |
|---|---|---|---|---|
| Consumers, Jersey City.... | 2,000,000 | 100 | 73 | 79 |
| " Bonds..... | 600,000 | 1,000 | 101 | .. |
| Cincinnati G. & C. Co..... | 7,000,000 | 100 | 201 | .. |
| Consumers, Toronto..... | 1,000,000 | 50 | 184½ | 187 |
| Capital, Sacramento..... | 500,000 | 50 | .. | 41 |
| Bonds (6's)..... | 150,000 | .. | .. | .. |
| Consolidated, Baltimore.... | 11,000,000 | 100 | 55 | 56 |
| Mortgage, 6's..... | 3,600,000 | .. | 107 | 107½ |
| Chesapeake, 1st 6's. .... | 1,000,000 | .. | .. | .. |
| Equitable, 1st 6's. ..... | 910,000 | .. | .. | .. |
| Consolidated, 1st 5's..... | 1,490,000 | .. | .. | .. |
| Detroit ..... | 4,000,000 | .. | .. | 29 |
| " Con. Bonds..... | 4,312,000 | .. | 71½ | 75 |
| Equitable Gas & Fuel Co., Chicago, Bonds..... | 2,000,000 | 1,000 | .. | 101 |
| Fort Wayne ..... | 2,000,000 | .. | 72½ | 75 |
| " Bonds..... | 2,000,000 | .. | 84 | 87 |
| Hartford..... | 750,000 | 25 | .. | 145 |
| Indianapolis..... ..... | 2,000,000 | .. | 140 | 145 |
| " Bonds, 6's..... | 2,650,000 | .. | 101½ | 103½ |
| Jersey City..... | 750,000 | 20 | 180 | .. |
| Lafayette Gas Co., Ind..... | 1,000,000 | 100 | 79 | 83 |
| Bonds ..... ..... | 1,000,000 | 1,000 | 85 | 87 |
| Louisville..... | 2,370,000 | 50 | .. | 130 |
| Laclede, St. Louis..... | 7,500,000 | 100 | 20¾ | 21 |
| Preferred..... ..... | 2,500,000 | 100 | 78 | 80 |
| Bonds ..... ..... | 9,084,400 | 1,000 | 94½ | 95 |
| Little Falls, N. Y..... | 50,000 | 100 | .. | 100 |
| Bonds..... ..... | 25,000 | .. | .. | 100 |
| Montreal, Canada ..... | 2,000,000 | 100 | 200 | - |
| Newark, N. J., Gas Co..... | 1,000,000 | .. | 75 | - |
| Bonds, 6's ..... | 4,000,000 | .. | 120 | .. |
| New Haven..... | 1,000,000 | 25 | 225 | .. |
| Oakland, Cal..... | 2,000,000 | .. | 46½ | .. |
| " Bonds..... | 750,000 | .. | .. | .. |
| Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage.... | 2,100,000 | 1,000 | .. | 108 |
| 2d " .... | 2,500,000 | 1,000 | 104 | 105 |
| Peoples, Jersey City..... | 500,000 | 50 | .. | 175 |
| Paterson, N. J..... | ..... | 25 | 99 | 102 |
| Rochester Gas & Elec. Co.. | 2,150,000 | 50 | .. | .. |
| Preferred..... ..... | 2,150,000 | 50 | 88 | .. |
| Consolidated 5's ..... | 2,000,000 | .. | 87½ | 90 |
| San Francisco, Cal. ..... | 10,000,000 | 100 | 71½ | 72 |
| St. Paul Gas Light Co..... | 1,500,000 | 100 | 68½ | 70 |
| 1st Mortgage, 6's..... | 650,000 | .. | 88 | 90 |
| Extension, 6's..... | 600,000 | .. | .. | .. |
| General Mortgage, 5's.. | 2,400,000 | .. | 88 | 90 |
| Syracuse, N. Y. ..... | 500,000 | 25 | .. | .. |
| Washington, D. C..... | 2,000,000 | 20 | 250 | .. |
| Western, Milwaukee..... | 4,000,000 | 100 | 63 | 65 |
| Bonds, 5's ..... | 3,556,000 | .. | 87 | 89 |
| Wilmington, Del..... | 500,000 | 50 | 188 | 190 |

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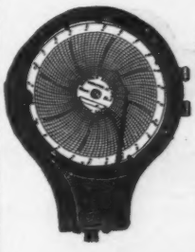

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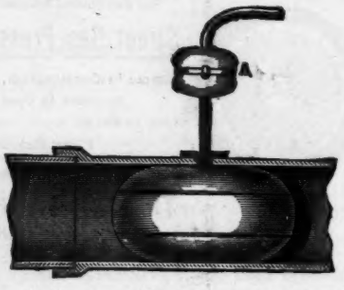


These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficiently inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

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| 5 " | " | " | 1.05 | 20 " | " | " | 12.00 |
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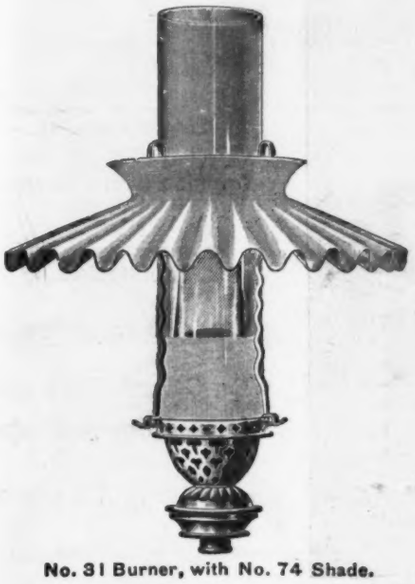

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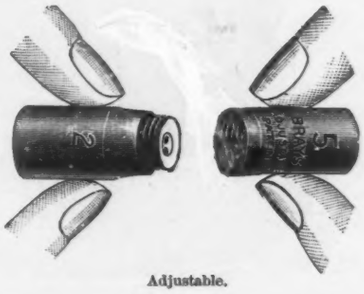

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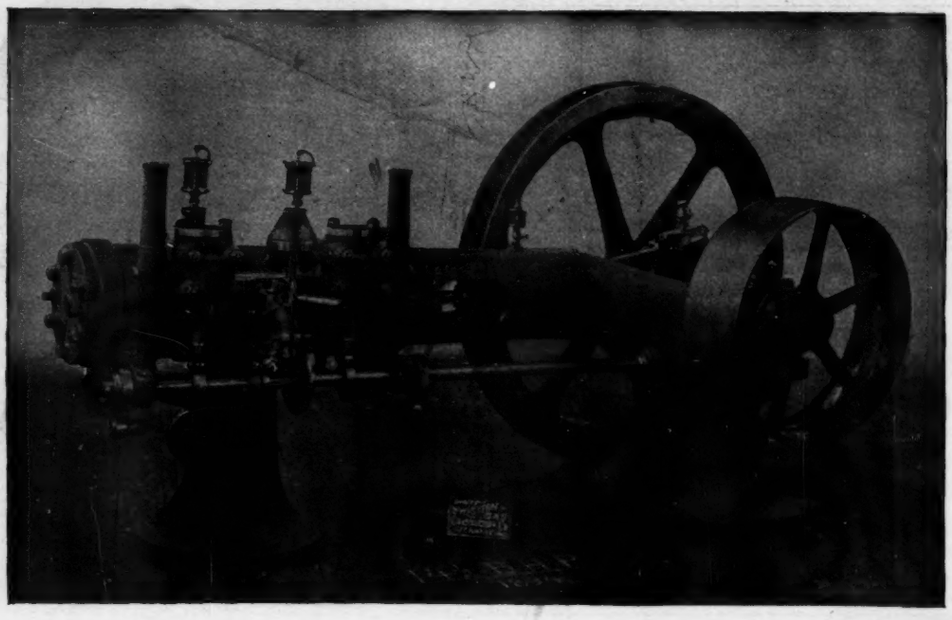

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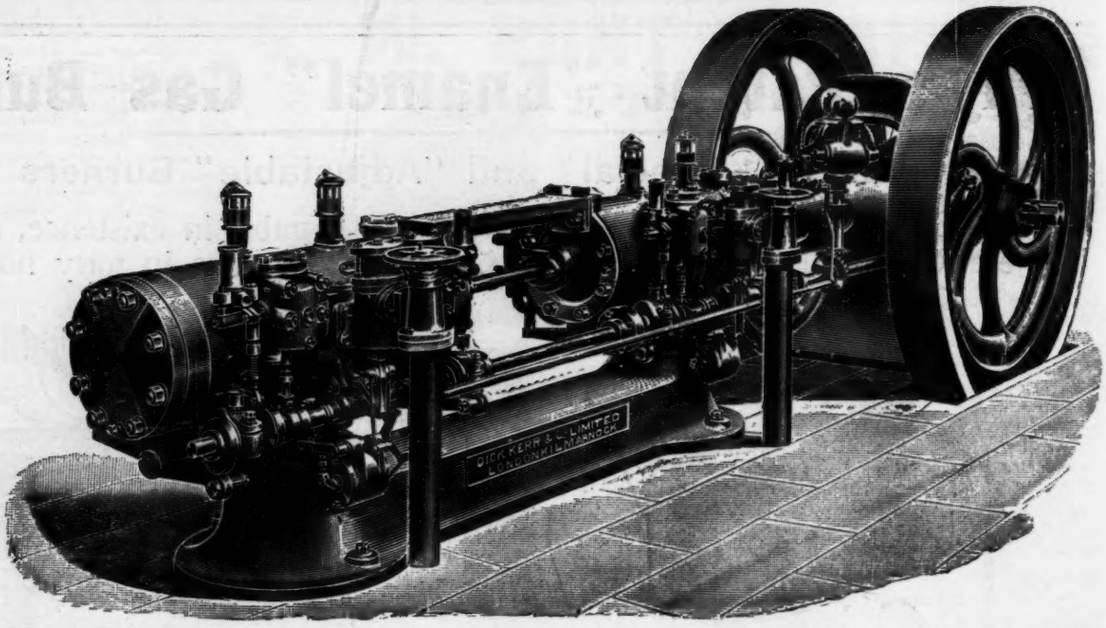


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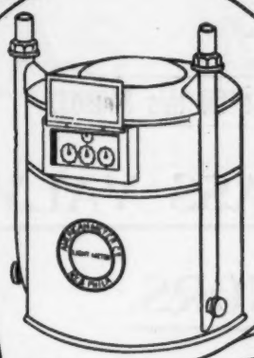
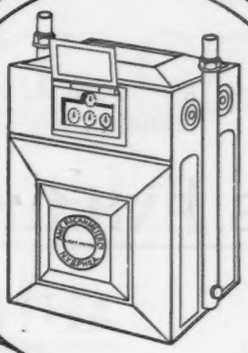
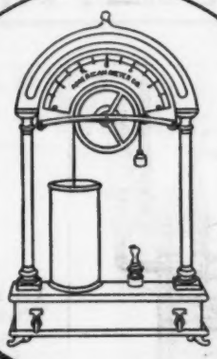
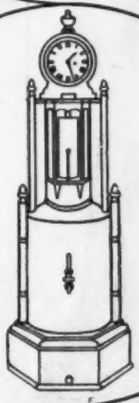
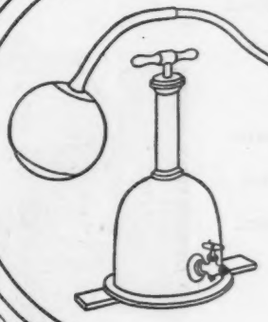






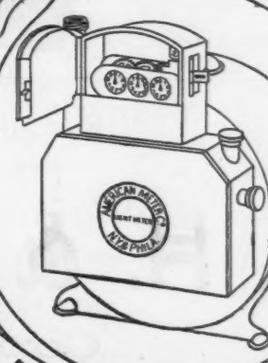




## PUBLIC LIGHTING TABLE.

### FEBRUARY, 1896.

| Day of Week. | Date. | Table No. 1. Following the Moon. Light. | Extinguish. | Table No. 2. New York City. All Night Lighting. Light. | Extinguish. |
|---|---|---|---|---|---|
| | | | | P.M. | A.M. |
| Sat. | 1 | 5.50 PM | 9.20 PM | 5.05 | 6.15 |
| Sun. | 2 | 5.50 | 10.40 | 5.05 | 6.15 |
| Mon. | 3 | 5.50 | 11.50 | 5.05 | 6.15 |
| Tue. | 4 | 5.50 | 1.10 AM | 5.05 | 6.15 |
| Wed. | 5 | 5.50 LQ | 2.20 | 5.10 | 6.10 |
| Thu. | 6 | 5.50 | 3.30 | 5.10 | 6.10 |
| Fri. | 7 | 5.50 | 4.40 | 5.10 | 6.10 |
| Sat | 8 | 5.50 | 5.40 | 5.10 | 6.10 |
| Sun. | 9 | 6.00 | 6.00 | 5.10 | 6.10 |
| Mon. | 10 | 6.00 | 6.00 | 5.10 | 6.10 |
| Tue. | 11 | 6.00 | 6.00 | 5.10 | 6.10 |
| Wed | 12 | 6.00 | 6.00 | 5.20 | 5 55 |
| Thu. | 13 | 6.00 NM | 6.00 | 5.20 | 5.55 |
| Fri | 14 | 6.00 | 6.00 | 5.20 | 5.55 |
| Sat. | 15 | 6.00 | 6.00 | 5.20 | 5.55 |
| Sun. | 16 | 6.10 | 5.50 | 5.20 | 5.55 |
| Mon. | 17 | 6.10 | 5.50 | 5.20 | 5.55 |
| Tue. | 18 | 9.40 | 5.50 | 5.20 | 5.55 |
| Wed | 19 | 10 40 | 5.50 | 5.30 | 5.55 |
| Thu. | 20 | 11.50 | 5.50 | 5.30 | 5.55 |
| Fri. | 21 | 12.50 AM FQ | 5.50 | 5.30 | 5.55 |
| Sat. | 22 | 1.50 | 5.50 | 5.30 | 5.55 |
| Sun. | 23 | 2.50 | 5.40 | 5.30 | 5.55 |
| Mon. | 24 | 3.40 | 5 40 | 5.30 | 5.55 |
| Tue. | 25 | 4.20 | 5 40 | 5.30 | 5.55 |
| Wed. | 26 | 5.00 | 5.40 | 5.30 | 5.45 |
| Thu. | 27 | No L. | No L. | 5.30 | 5.45 |
| Fri. | 28 | No L. FM | No L. | 5.30 | 5.45 |
| Sat. | 29 | No L. | No L. | 5.30 | 5.45 |



### TOTAL HOURS LIGHTING DURING 1896.

| By Table No. 1. | Hrs.Min. | By Table No. 2. | Hrs.Min. |
|---|---|---|---|
| January | 220.40 | January | 423.20 |
| February | 207.00 | February | 367.40 |
| March | 193.00 | March | 355.35 |
| April | 174.10 | April | 298.50 |
| May | 164.00 | May | 264.50 |
| June | 142.10 | June | 234.25 |
| July | 142 10 | July | 243.45 |
| August | 150.50 | August | 280.25 |
| September | 163.00 | September | 321.15 |
| October | 193.10 | October | 374.30 |
| November | 207.00 | November | 401.40 |
| December | 237.30 | December | 433.45 |
| Total, yr. | 2194.40 | Total, yr. | 4000.00 |

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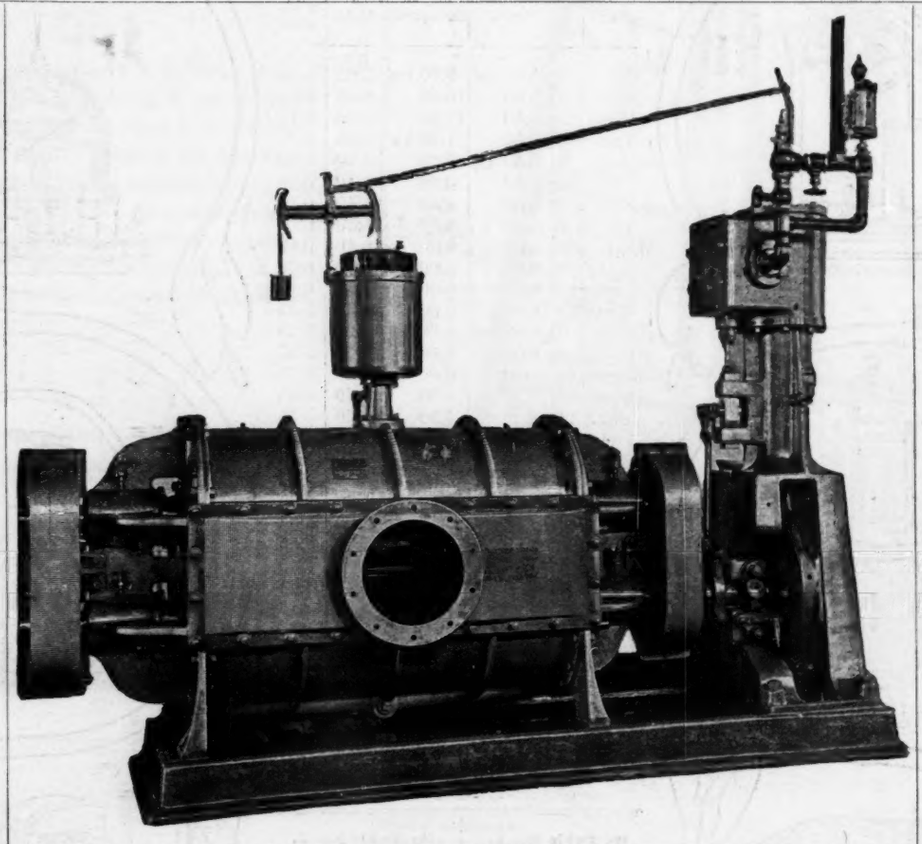

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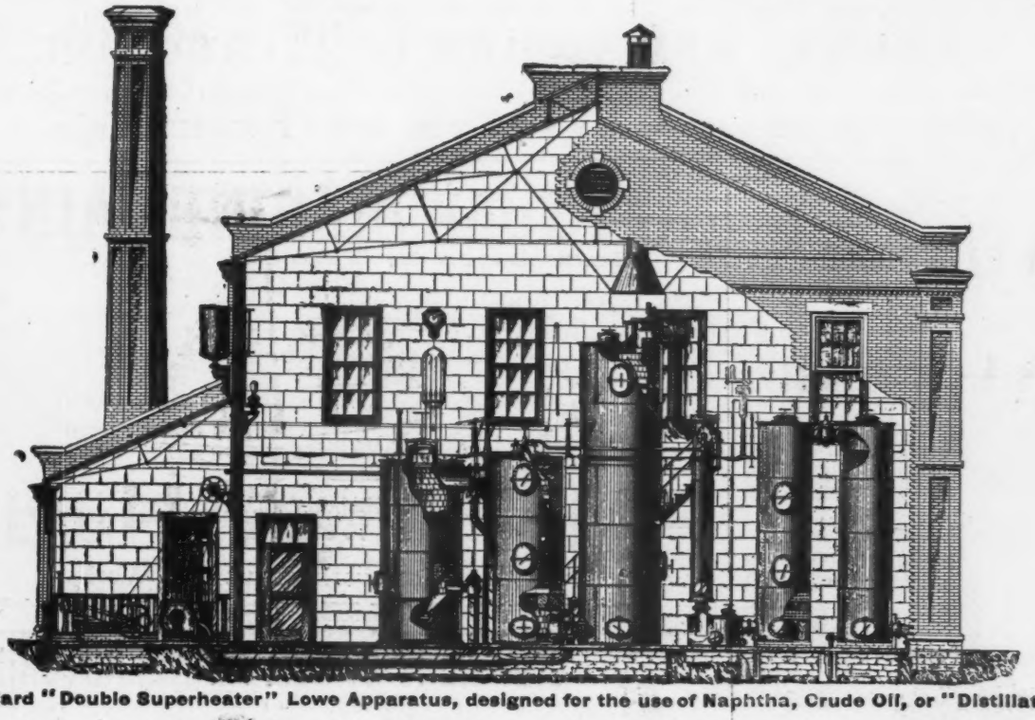

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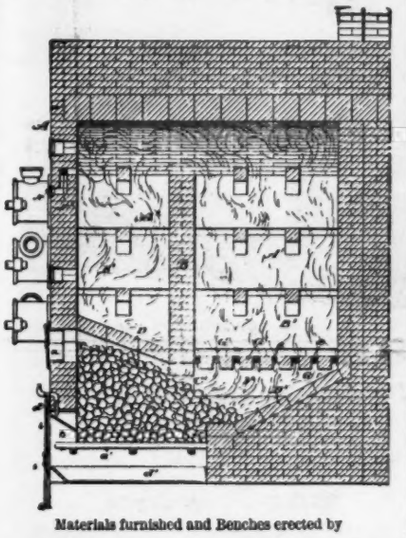

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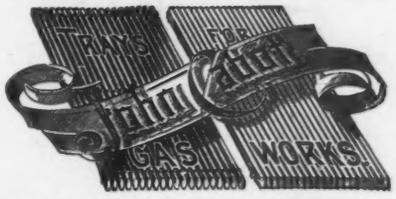


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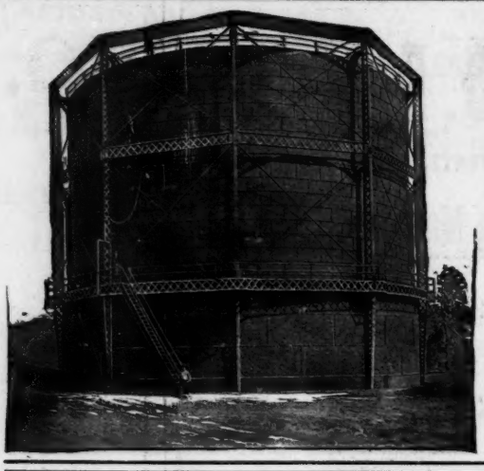

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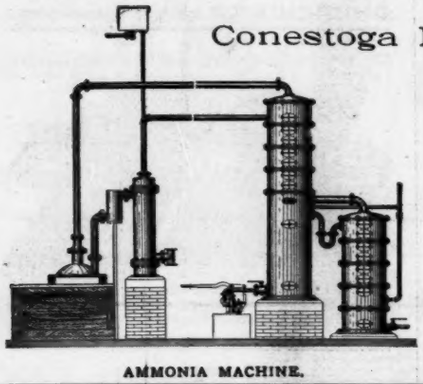

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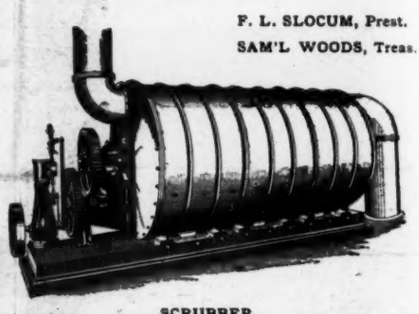

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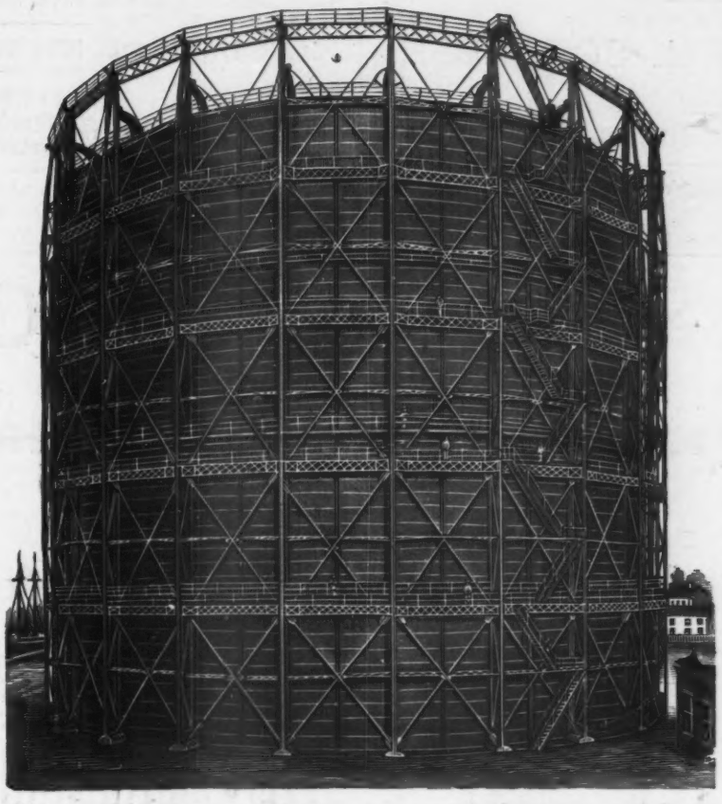

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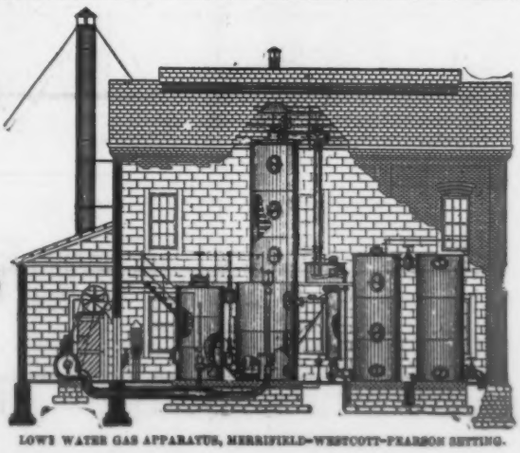

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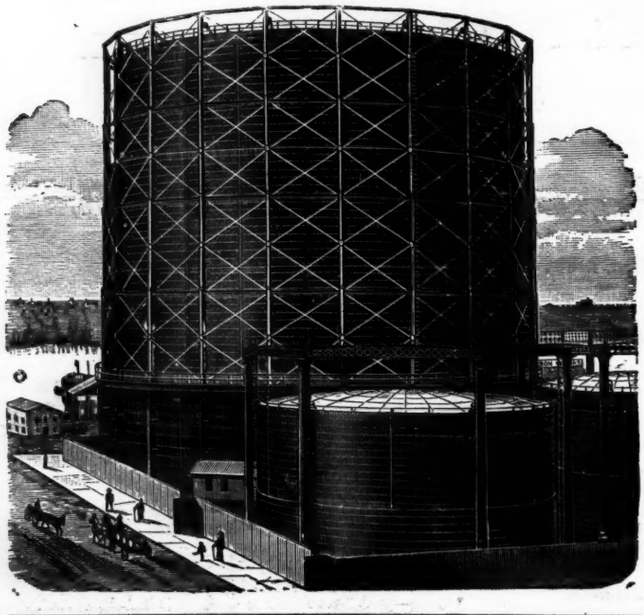

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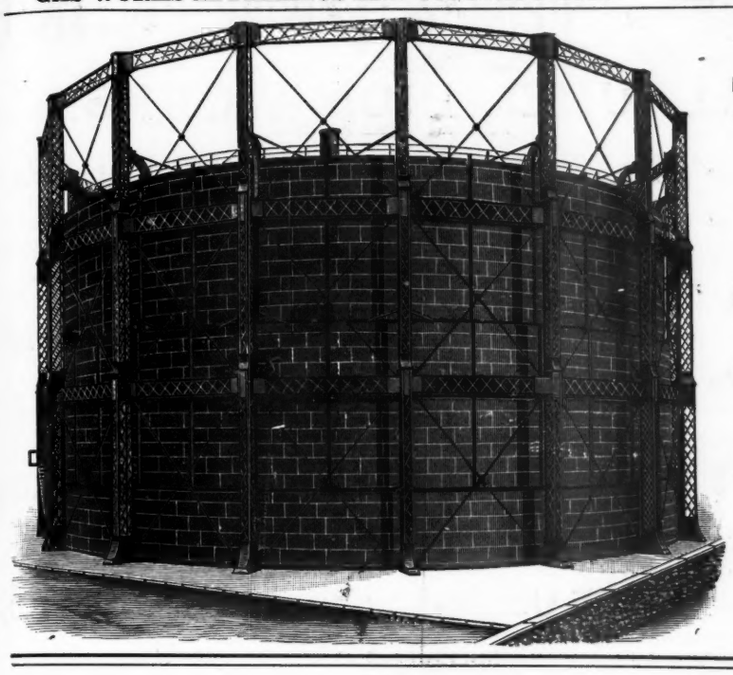

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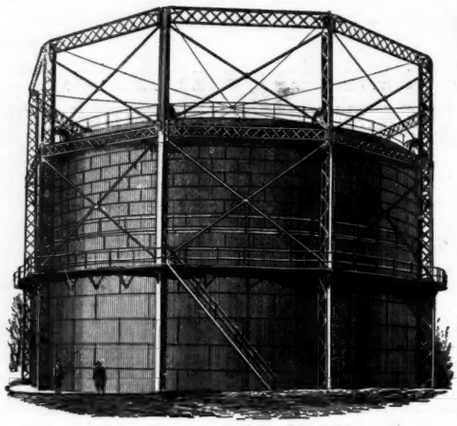

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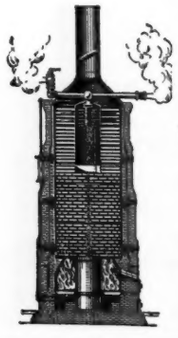

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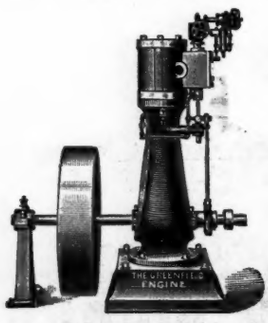

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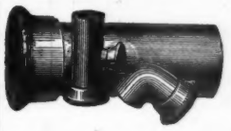

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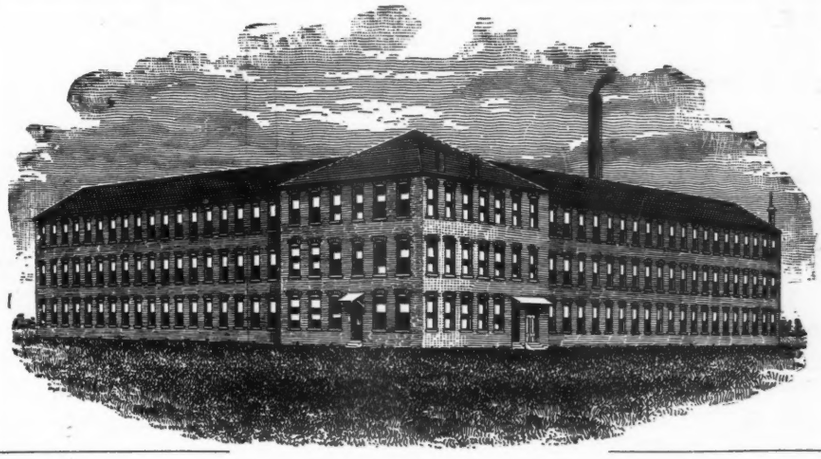

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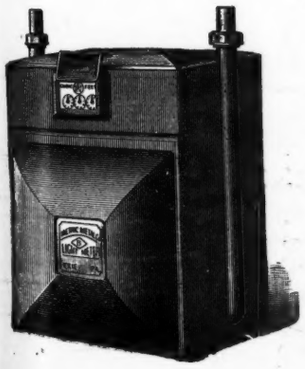

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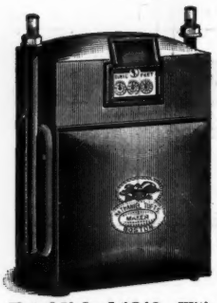

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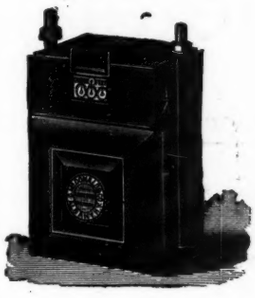

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